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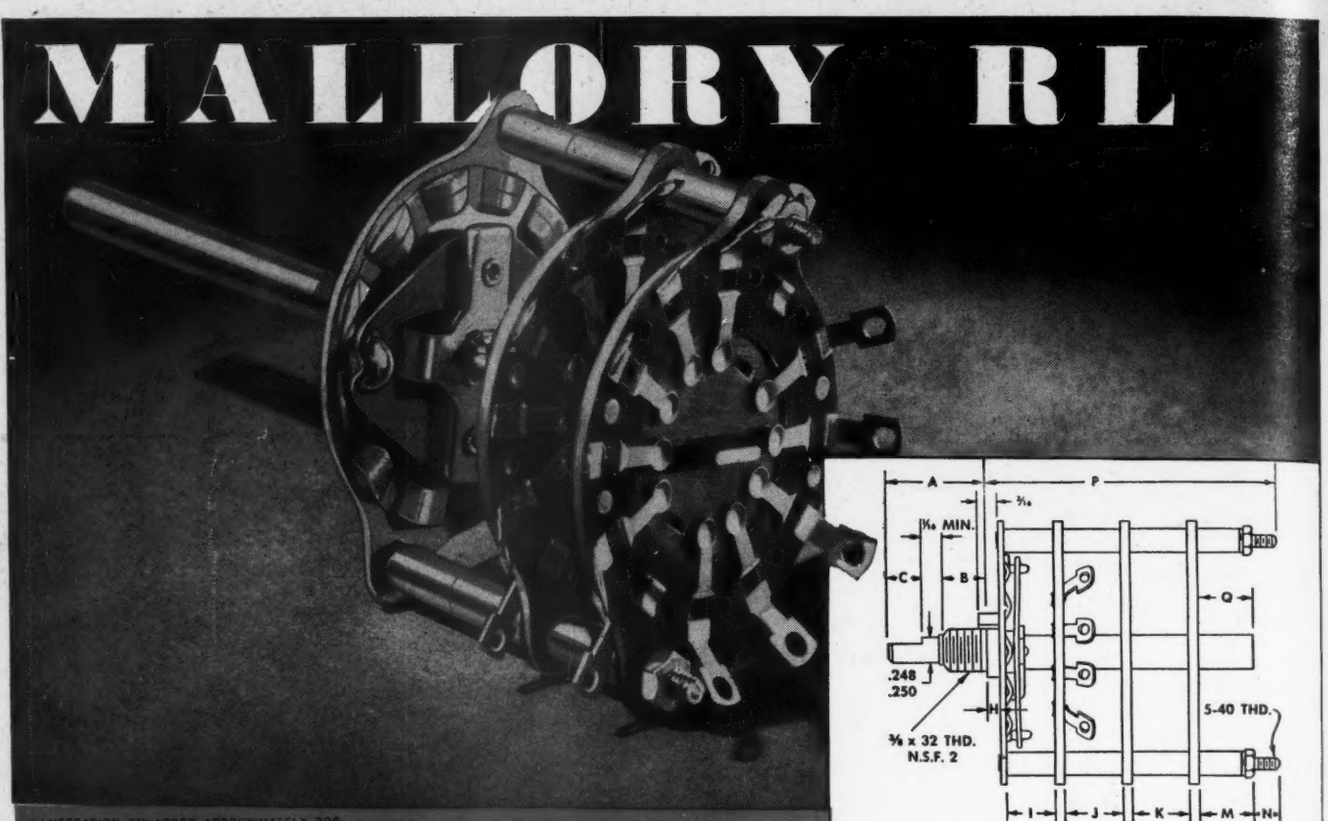
MALLORY RL



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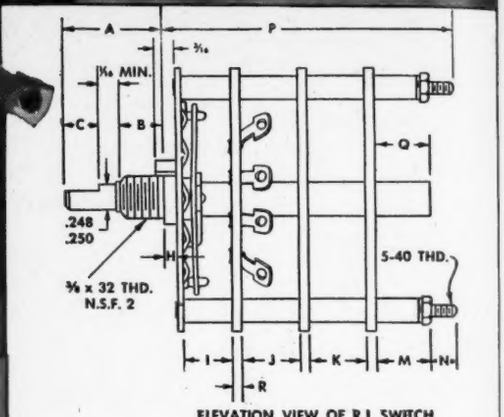

ELEVATION VIEW OF R L SWITCH

Ask for RL Specification-Layout Sheets

Printed on thin paper to permit blueprinting, these sectional drawings indicate standard and optional dimensions—make it easy for you to order pre-production samples of RL switches built to meet your requirements exactly. Ask your nearest Mallory Field Representative or write direct for a supply.

OF all circuit selector switches manufactured by Mallory, this RL unit is the most popular by far for low-power, industrial applications. In a class by itself, the RL switch is the answer for industrial electronic equipment requiring greater durability than provided by the conventional radio circuit selector switch. It offers from 1 to 6 circuits per section with 30 degree indexing—from 1 to 3 circuits per section when 60 degree indexing is used. But that's not the whole story by any means.

The heavy self-supporting terminals of this switch, for instance, are clinched to the stator and held firmly without rivets or staples. Contact ends are ball shaped, formed of high quality spring brass material, and heavily silver plated.

The rotor contact member is made of solid silver, insuring much lower contact resistance. The high lift of the terminals makes possible a self-cleaning action which further improves electrical contact. High quality Bakelite in the stator provides ample insulation for general applications, yet is sturdy enough to withstand rough usage.

These are only a few of many reasons why this RL switch is found in radio instruments, test equipment, and a wide variety of other applications. For full information about this Mallory "leader", ask for the RL Engineering data folder and specification layout sheets, or see your Mallory representative. Standard Mallory Switches are obtainable from your nearest Mallory Distributor.

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(INDUSTRIAL AND ELECTRONIC)

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ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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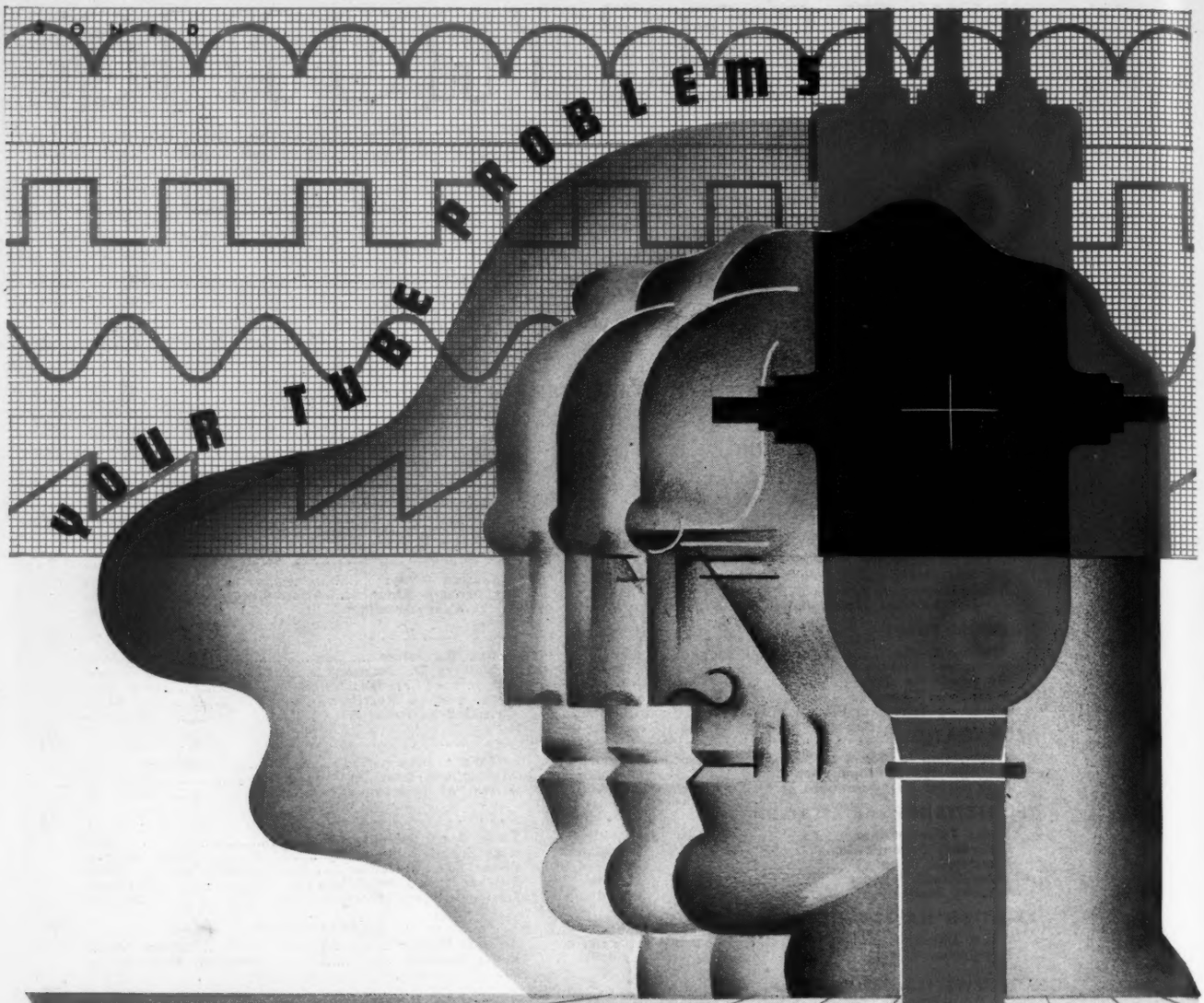

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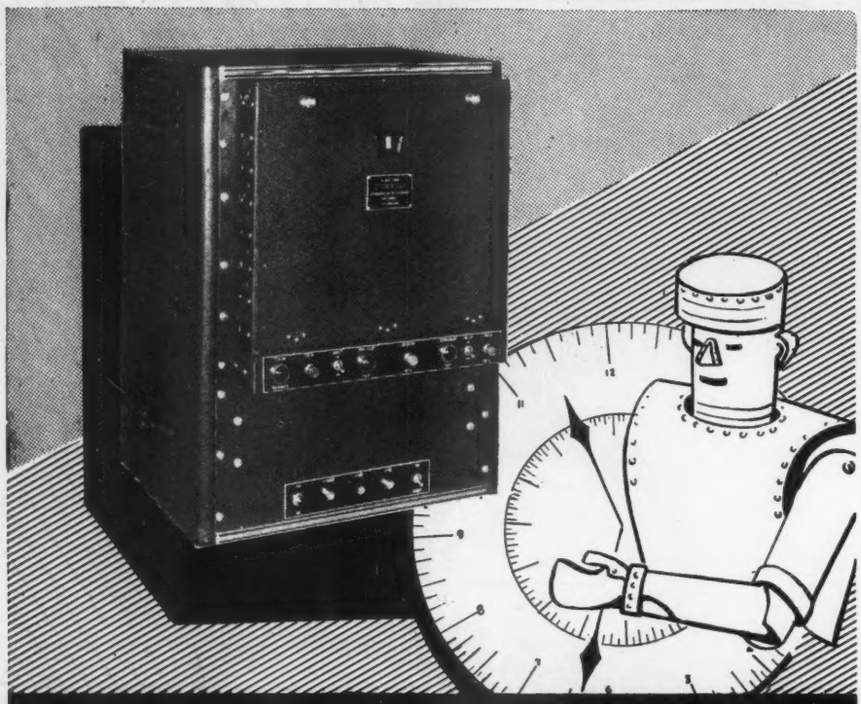

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THE COVER

(*See also page* 58)

The illustration shows an electrolytic tank used to design multi-stage wide band amplifiers for television receivers in the Philco Laboratories. Making use of a strange but very accurate mathematical similarity between the frequency characteristics of electrical networks and the distribution of potential in a tank of electrolytic, the method makes possible the achievement of more nearly ideal characteristics with high gain per stage. Amplifiers designed by this procedure may have very simple interstage coupling networks, all aligned somewhat differently so as cooperatively to produce an assigned overall gain and phase versus frequency response.

In the apparatus shown, a large shallow pool of slightly salted water is contained in a dielectric tray with a round strip of copper around the edge for a ground return. Equal currents are fed to the water through probes, at specific points near the center of the pool, their arrangement corresponding to the arrangement in the complex frequency plane of the resonances of the several amplifier stages. The potential in the water along a straight line passing near to the probes and corresponding to the axis of real frequencies is a measure of the gain in DB of the final amplifier, while the potential gradient transverse to the axis gives the slope of the phase versus frequency curve. The "resonances" are moved about at will until the required characteristics along the axis are obtained.

The theory of the method was worked out and applied by the Philco Research Laboratories in the course of television circuit development during 1939 and 1940. It has since been extensively used on the more exacting problems of wide band amplifier design.—W. E. Bradley, Director of Research, Philco Corp.

Inky! Woof!

Know what an "inky" is? Or a "scoop"? Or, for that matter, what "woof" means? Definitions of these, and some 250 other commonly used television terms, are included in a 64-page cartoon-illustrated "Television Talk," just published by the National Broadcasting Co.

ELECTRONIC INDUSTRIES
Including INDUSTRIAL ELECTRONICS
O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17), N. Y.

Engineering vs Sales Costs

It is time radio engineers looked more closely into the marketing methods by which their products pass to the consumer, a well-known manufacturing executive reminds us:

"Engineers devotedly work their slide rules and compute costs down to fractions of a decimal point. They apply every economy that technical ingenuity and resourcefulness can devise.

"But when the product goes to the average sales department, nobody knows—or can tell within 20 or 30 per cent—what the final costs of distribution will be for the same product that has been factory-cost-analyzed down to a hair. Through faulty sales policies or misjudging of the market, we may toss away a hundred times all the patient savings of the engineering department and factory, because market determination has not yet been put on an equivalent basis of engineering and sound knowledge."

Let's Put Color-TV to the Test

CBS in recent weeks has achieved some striking demonstrations of uhf color-television. All credit to its engineers in pioneering this new field of great promise. Hundreds who witnessed these New York presentations agree that color, when available as there shown, will tremendously increase the public's demand for TV sets.

If color-television on 490 mc, rich in detail and free of ghosts, is everything that its adherents promise for it, we would like to see a practical color-video broadcast operation carried out in some metropolitan center, without delay,—even without waiting for the industry to pow-wow and standardize. Much would be learned by all hands.

An Experiment in Public

If, say, CBS will broadcast color-television programs from its Chrysler Tower antenna several times weekly, we are sure hundreds of engineers, experimenters, and hams would quickly join in the experiment with sets of their own construction. Color telesets could possibly be supplied by local custom-builders at around $500, for laymen willing to participate. Such public experimentation would produce the answers to many questions that now bother both engineers and business executives.

And even the public, we suspect, would be quick to observe, compare, and buy—or try to buy!

Let's put color-tele to a practical public test without delay.

Keeping Things Constant

Much of the problem of delivering electrical power is in keeping the voltage constant. Of late it has been shown that tubes, making use of electrons "freed from the bondage of wires", can do a better job than can manual control at the switchboard!!

As a result, constant voltage—with its equally important brothers, constant frequency, constant speed, constant temperature, and constant-everything-else-you-can-think-of—have opened doors to countless new industries, products and jobs, so that many times the number of manual switch-throwers displaced, now have more interesting and better-paying positions. And today the power engineer deals with electronic equipment many times more complicated than the old switches and capable of doing jobs that the best of switches and the best and quickest operators could manual control at the switchboard.

New Possibilities of Control

Keeping things constant is only one effect that an electron tube can handle. Many farsighted engineers have noted that for the majority of situations, non-linear control would be even better. Here, again, electron tubes have taken over, in jobs where human control would not be effective.

A motor driving a lathe might better have its speed controlled according to the load, delivering maximum speed consistent with its own capabilities, the heating up of the work, or the strains on the tool, so as to get most work done per hour.

A chemical mixing machine might have its temperature controlled in accordance with some intricate set of conditions inherent with the mixture.

In applications like these, electronic control performs functions no human could ever undertake.

Month After Next, Watch for Electronic Industries'

May Marketing and Directory Number

Marking the 1946 Radio Electronic Parts Trade Show, Hotel Stevens, Chicago, May 13-16

NETWORK DESIGN USING F

By RICHARD W. KENYON
Electronic Industries

Relationship of function theory to potential theory simplifies design of electronic networks for television

• Gain and phase characteristics of wide or narrow band amplifiers may be obtained by use of an electrolytic tank which simulates the complex plane. This method was discovered during practical work in the design of television receivers by the Philco Radio & Television Co., between 1938 and 1941. It provided the first completely general design method of compensated multi-stage amplifiers. Tedious mathematics and experimentation have been eliminated, once the scalar quantities of the tank are established.

The complex plane tank representation is used because it bridges the gap between electrostatics and function theory. In the most elementary sense, tuned circuits have points of resonance and anti-resonance wihch are known as zeros and poles, respectively. The gain of an amplifier as a function of frequency may be handled very simply, when the complex variable solution is considered.

Mathematically speaking, every amplifier has specific complex frequencies at which the gain is infinity, and other complex frequencies at which the gain is zero. The subject of complex variables is not commonly known to engineers. An important fact of this form of mathematics is that a function is completely determined if the values of the variables which cause the function to be infinite, or zero, and one specific value of the function are known. It is possible in the complex plane electrolytic tank, to locate these poles and zeros which control the shape of a frequency-gain curve.

Relationship between electrostatics and function theory may be shown by considering a parallel resonant circuit. The admittance from A to B is the sum of the branch admittances:

$$Y = j\omega c + \frac{1}{j\omega L} + G \qquad (1)$$

The voltage across A B is:

$$E = \frac{I}{Y} = \frac{I}{\lambda C + \frac{1}{\lambda L} + G}$$

$$Z = \frac{E}{I} = \frac{\lambda}{C\left(\lambda^2 + \frac{1}{CL} + \frac{\lambda G}{C}\right)} \qquad (2)$$

Solving the denominator quadratic for:

$$\lambda_{o,p} = -\frac{G}{2C} \pm \sqrt{\left(\frac{G}{2C}\right)^2 - \frac{1}{LC}}$$

$$= -\frac{G}{2C} \pm j\sqrt{\omega_o^2 - \left(\frac{G}{2C}\right)^2} \qquad (3)$$

$$= -\frac{\omega_o}{2Q} \pm j\sqrt{\omega_o^2 - \frac{\omega_o^2}{4Q^2}}$$

$$\lambda_{o,p} = -\frac{\omega_o}{2Q} \pm j\omega\sqrt{1 - \frac{1}{4Q^2}} \qquad (4)$$

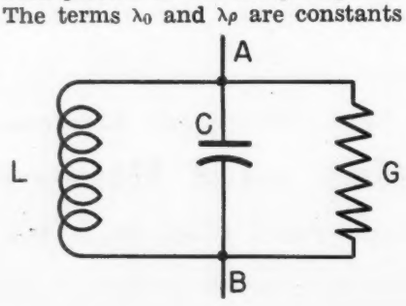
Two solutions are thus indicated.

The apparent fact that a parallel tuned resonant circuit has two poles has an interesting basis. An angular velocity may be represented by two oppositely rotating vectors whose sum is at all times equal to the cosine of the angular displacement. This may be shown by the well-known relation:

$$\text{Cos } \omega t = \frac{1}{2}\left(e^{j\omega t} + e^{-j\omega t}\right)$$

Usually the imaginary term is neglected. In complex variables, however, this term is included, and represents the second portion of the above solution.

These components of λ_0, ρ are then plotted on the complex plane. The terms λ_0 and $\lambda\rho$ are constants



depending only on the "R, L, C's" of the network.

Equation 2 may be written as:

$$Z = \frac{\lambda}{C(\lambda - \lambda_o)(\lambda - \lambda_p)} \qquad (5)$$

This is in the form of the typical gain function equation:

$$A_{(\lambda)} = H\frac{(\lambda - \lambda_{o1})(\lambda - \lambda_{o2})}{(\lambda - \lambda_{p1})(\lambda - \lambda_{p1})_2} \qquad (6)$$

in which A is the gain, H is a constant not involving λ and $\lambda = jw$. The terms λ_{o1}, λ_{o2} represent zeros, while λ_{p1} and λ_{p2} are poles. Equation 6 shows that the product of the pole distances to the center frequency is inversely proportional to amplifier gain.

Pole and zero location

Either component or systems problems can be solved by the utilization of pole patterns. The set-up arranged in Fig. 2 is for either a double-tuned circuit or two single-tuned stages. Component pole arrangement is shown in Fig. 1, while the complete system is illustrated in Fig. 5.

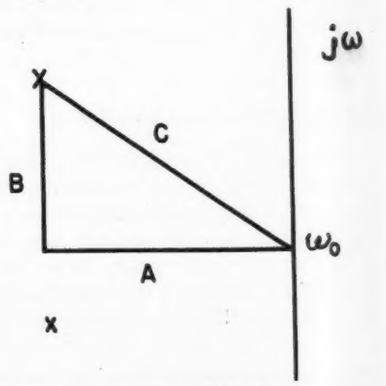


Fig. 1—Pole location coordinates

The position of the poles controls the circuit components. Distance from the jω axis represents the circuit damping. Distance measured along the jω axis is adjusted by circuit tuning constants. Real and

ELECTROLYTIC TANKS

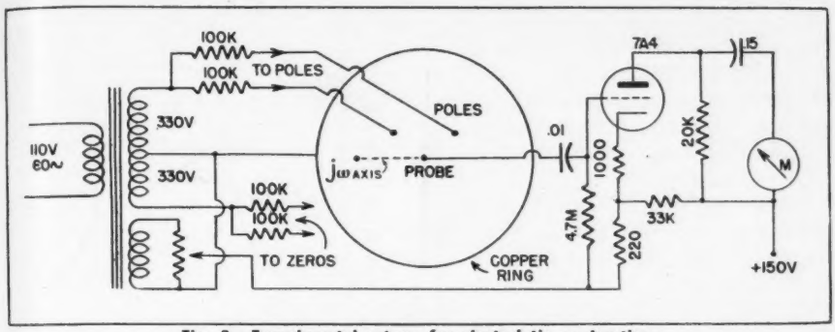


Fig. 2—Experimental set-up for electrolytic exploration

imaginary parts of λ are plotted as indicated in Fig. 1.

In a double-tuned transformer when $Q_{11} = Q_{22}$, and $\omega_{11} = \omega_{22} = \omega_o$, the coordinates have the following values: $A = \frac{\omega_o}{2Q}$, $B = \pm\frac{\omega_o K}{2}$ in which K is the coefficient of coupling. As a generalized pattern, the poles may be arranged in a line parallel to the jω axis. This form will give a good phase response. Adjustment of distance A will determine the desired circuit Q.

Basic values for pole location are as follows:

When $Q_{11}=Q_{22}$ and $W_{11}=W_{22}=W_o$

$A = \frac{\omega_o}{2Q}$ $\qquad B = \frac{\omega_o k}{2}$

When $Q_{11} \neq Q_{22}$ and $W_{11}=W_{22}=W_o$

$A = \frac{\omega_o}{4Q_{11}}$ $\qquad B = \frac{\omega_o k}{2}$

When $Q_{11}=Q_{22}$ but $W_{11} \neq W_{22}$

$A = \frac{\omega_o}{2Q_{11}}$ $\qquad B = \pm\sqrt{\left(\frac{\omega_o k}{2}\right)^2 + \frac{(\omega_{11}-\omega_{22})^2}{2}}$

The dimensions A and B refer to Fig. 1.

A circle drawn of unit radius is shown in Fig. 4. Grouping in this circuit would represent either six single-tuned stages or three double-tuned stages. Final choice of the single or double transformer would resolve itself into the dimensions assigned to A and B. Experimental patterns of ellipses about the jω axis give favorable results. Relationship between gain, phase, and frequency is shown in Fig. 3. A zero may be introduced into the tank by connecting the opposite phase to an electrode. Zeros may be considered to be wave traps.

Gain-frequency plot

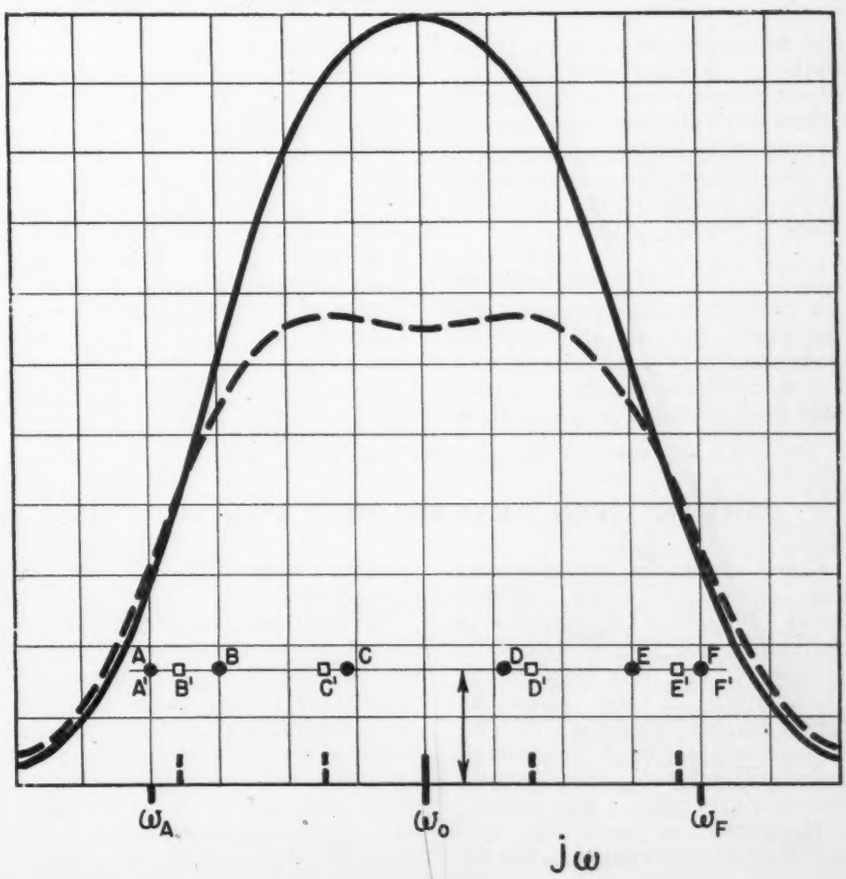
In operation, the probe electrode and associated VTVM read directly the gain of the amplifier (Fig. 2). The probe is moved along the jω axis, and voltages are recorded at frequency intervals. A gain-frequency curve for the network is the result. If the probe is set at a given frequency and then moved a unit distance perpendicular to the jω axis in the direction of the poles, an indication of the slope of the phase shift curve results. The voltage change recorded is a measure of the slope of the phase-frequency response curve. Since this information is more useful than the phase curve itself, the engineer has all the necessary amplifier design data.

It can be seen in Fig. 5 that if six poles are located at A, B, C, D, E, F, a high gain will result. Shifting poles to B^1, C^1, D^1, and E^1, causes the gain-frequency curve to broaden. This is attributed to the change in individual resonant frequencies and coefficient of couplings.

Scalar values of the results are easily obtained since the jω axis is plotted in frequency and the real axis is also a function of frequency. The voltage readings between points are therefore percentages of frequency, hence, unknown quantities can be determined.

The method outlined indicates the pole placement procedure. Thin brass rods are used as the simulated poles and zeros. As seen in Fig. 2, the poles are connected to one end of the transformer while the zeros

Fig. 5—Relationship of gain-frequency curve to pole position



Potential gradients are formed by the introduction of voltages applied to brass electrodes in an electrolytic tank. Exploration of these gradients can determine the circuit constants of any network, by relating function theory to potential theory.

The method is helpful in tying down specifications and estimating the effect of small capacitance variations. In addition it affords interesting information regarding production alignment methods.

Basically the method consists of dividing the design problem into two parts: first, the arranging of poles and zeros of the gain function of the amplifier to produce the desired type of frequency response, and second, the choice and design of individual interstage coupling networks to build up as efficiently as possible the chosen arrangement of poles and zeros. Each of these two sub-problems is readily solved although each has its special technique.

Ordinarily, an engineer has only to look through a "scrapbook" of pole patterns until he finds the nearest to the solution he desires and then, with a little experimentation with a large piece of graph paper and a slide rule, finds one exactly fitting his requirements as to shape of frequency response, attenuation outside the band, linearity of phase shift, etc.

When the placement of poles and zeros is decided, the engineer next consults a table of design data and chooses the most efficient or economical allocation of poles and zeros to the individual stages and also the detailed design of each stage. He ends up with curves showing the frequency response of each stage, knowledge of the correct Q as well as the resonant frequency of each tuned circuit, and curves of overall phase and amplitude characteristics. He also has the assurance that he has an optimum design in the sense that no other adjustment of the same tuned circuits could be better than that chosen with respect to gain and fidelity.

are connected to the other end. Ordinary tap water usually has sufficient mineral content for current conduction. Typical currents are 2.5 ma. Probe exploration along the $j\omega$ axis, will give the gain-frequency curve. Indication on the calibrated meter is directly in DB.

Merit of method

A further analogy between the electrolytic tank and radio networks is seen in the fact that the current flow surrounding the poles is uniform. Similarity to a network driven by a constant current generator is readily seen. One of the interesting by-products of this method was the discovery that two multi-stage amplifiers may have the same stage band width and amplitude characteristics and transient performance with identical tube circuit capacity and yet have very different gain from the same number of stages.

This important fact adds significance to the design system here presented because of the means it affords systematically choosing the most efficient design for a given set of requirements. The experimental method has so many degrees of freedom that there is always the question of whether or not the solution finally arrived at is optimum. The electrolytic tank method is conclusive.

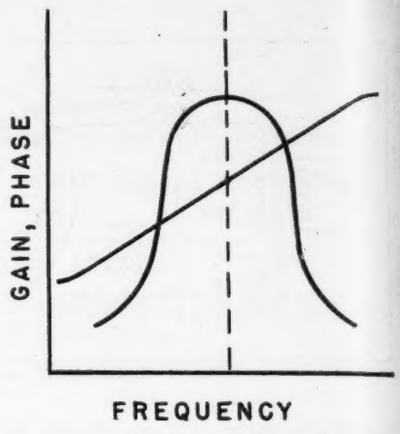


Fig. 3—Typical gain, phase curve

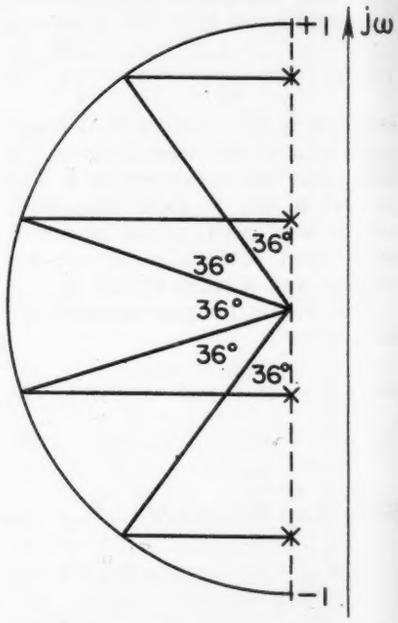


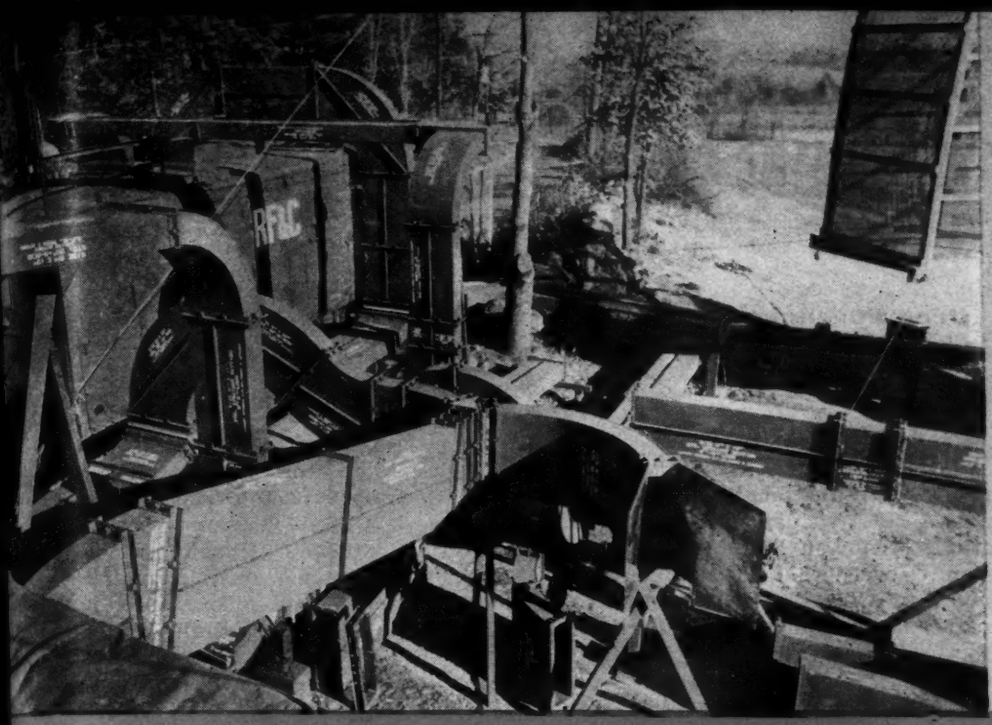
Fig. 4—Pole position circle

"NAVAR" AND "NAVAGLOBE" PROPOSED FOR AIRPLANE NAVIGATION

A new system of traffic control and navigation along airways called "Navar"—a contraction of Navigation and Radar—has been proposed to the War Department, Headquarters of the Army Air Forces, by Henri Busignies, director of the Laboratories of the Federal Telephone and Radio Corp. Coupled with this presentation was another —"Navaglobe"—a world-wide system of long range radio beacons for aircraft, strategically located around the earth.

As described, the "Navar" system would project an electronic "moving picture" on a chart in a given airport control center, showing the exact location and identity of every plane in the sky within eighty miles of the airport. In addition to the constantly moving Radar picture in the ground-based control room, the pilot of a Navar-equipped plane will see on his own scope his own and all other aircraft near his position and altitude, in relation both to each other and the ground.

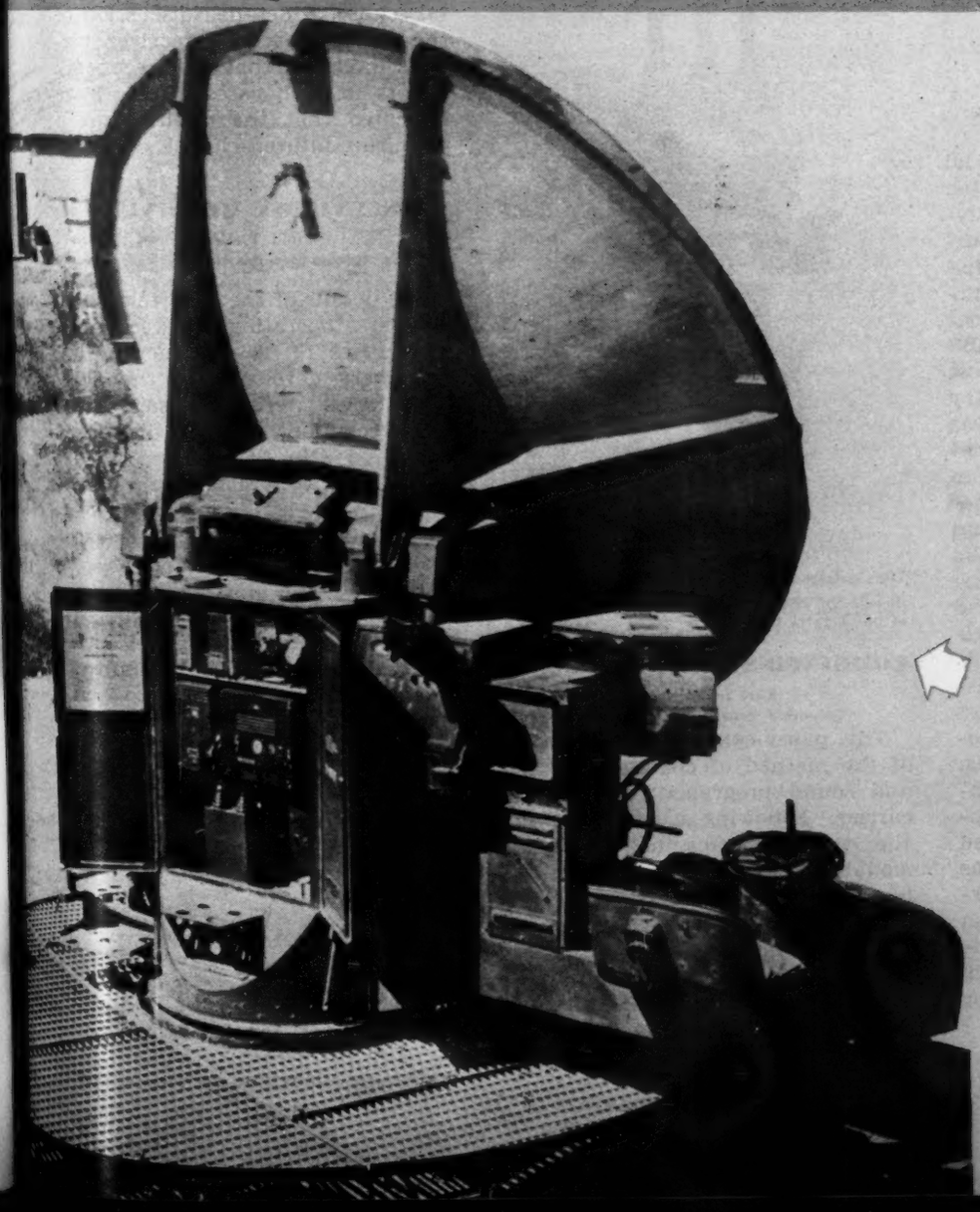
Navaglobe is a perfected application of present and long-proven technics of aerial radio navigation. The system would require 58 Navaglobe radio beacons to provide unbroken long-range airways for the entire ocean area of the earth, and 75 including continents.



Waveguide feed system for the antenna of the giant "Tuba" jammer. Is 1,000 times as powerful as previous jammers in this frequency range. Electronic system uses resnatron tetrode tunable over wide frequency range, modulated by random noise. Output power is approximately 50 kw, at typical operating frequency of 1,500 mc. Experimental model used huge parabolic antenna called "Tuba" to distinguish it from smaller "Piccolo," "Flute," etc. Resnatron tube was developed by NDRC under Signal Corps sponsorship.

RADAR COUNTERMEASURES

High power developed continuously at high frequencies by resnatron greatly reduces effectiveness of enemy equipment



Captured German "Wurzburg" anti-aircraft fire-control radar operated at 25% effectiveness because of jamming and "window". Mainstay of Nazi anti-aircraft fire control system at night and on overcast days, these radars represented billion-dollar investment. Tracking precision of "Wurzburg" radar is equal to optical precision, and 4,000 were in use in 1945; each requires ten operators. When "window" was dropped in 1943 over Hamburg, radar operators exclaimed, "The planes are doubling themselves!" In October 1943, "window" was followed by "carpet", electronic jammer carried one to a plane. Nazis countered with anti-jamming measures: shifted operating frequency of "Wurzburgs", built gadgets to distinguish between moving and stationary targets. Ninety percent of Nazi UHF engineers were working on anti-jamming projects at end of 1944, by German estimates. Prize of 700,000 Reichsmarks was offered for best anti-window device.

IRE WINTER TECHNICAL

Over 80 engineering papers discussed by record attendance as engineering exhibits of 135 manufacturers fill two floors

• Nothing but superlatives will do for the 1946 Winter Technical Meeting of the Institute of Radio Engineers. It was the largest gathering ever held, with registration slightly over 7000 which compares with some 3000-odd last year (total membership is in the neighborhood of 16,000); there were 2200 at the thirty-fourth anniversary banquet; 135 manufacturers jam-packed two floors of the hotel with 170 exhibits of electronic equipment, parts, complete transmitters; over 80 technical papers filled three meeting rooms simultaneously during the four days, January 23-26. IRE virtually took over the Hotel Astor in New York, with exhibits overflowing into other hotels.

Officially the meetings opened with a joint session participated in by members of the American Institute of Electrical Engineers and the IRE. Major General Leslie R. Groves addressed the session and talked about "Some Electrical, Engineering and General Aspects of the Atomic Bomb Project". Among matters of routine business IRE presented the Morris Liebmann Memorial Prize to Dr. Peter C. Goldmark, CBS's television expert, and the Institute's Medal of Honor to Ralph Vinton Lyon Hartley of Bell labs; awarded fellowships to 15 members: Gregory Breit, Walter C. Evans, Ronald J. Rockwell, Merle Anthony Tuve, Clarence W. Hansell, Arthur H. Samuel, Henri G. Busignies, Harold L. Kirke, Joseph Slepian, Howard A. Chinn, Elmer D. McArthur, William O. Swinyard, Thomas L. Eckersley, Harold S. Osborn and Julius Stratton.

BRIEFING THE IRE WINTER TECHNICAL MEETING PAPERS

TELEVISION

STUDIO EQUIPMENT

James J. Reeves and Peter C. Goldmark
Columbia Broadcasting System

The first portion of the technical session on television was devoted to a description of the recently-installed television transmitter using the 480-500 megacycle transmission band, and other transmitters and associated equipment being experimented with by the CBS group. The transmitter is the most powerful design for this frequency and bandwidth. The subject was introduced by Goldmark who described the problems involved in the development of the transmitter utilizing these frequencies and gave a brief survey of the results of recent tests, including experiments on color. The tests created much enthusiasm among the engineers who conducted them, by reason of the coverage of the transmitter and the freedom from ghost images experienced at receiver locations in the Metropolitan area. In regard to the design of the camera and studio control room equipment used in this system, described by Reeves, the arrangement was shown to be versatile, and will permit transmission of high definition television using the 525 line standards, now in use, as well as 1,029 line black and white images, or high definition color television.

The Federal type 6C22 tube which found use in CBS transmitter the setup of which is shown in block form on opposite page

COMBINED SIGHT AND SOUND

Kurt Schlesinger
Columbia Broadcasting System

This paper concerned the details of the method of combining sight and sound programs on a single carrier. Following a description of the various forms of multiplex modulation that are possible, pulse frequency modulation used in these experiments was described. Here, a 7.8 mc modulation signal was frequency modulated ±600 kc. These modulated pulses appear during the flyback intervals between horizontal scans. A detailed discussion of the transmitter and receiver circuits indicated that some economy results in both cases. Tests have indicated that the method has a promising future.

TELEVISION RECEIVERS

Harold T. Lyman
Columbia Broadcasting System

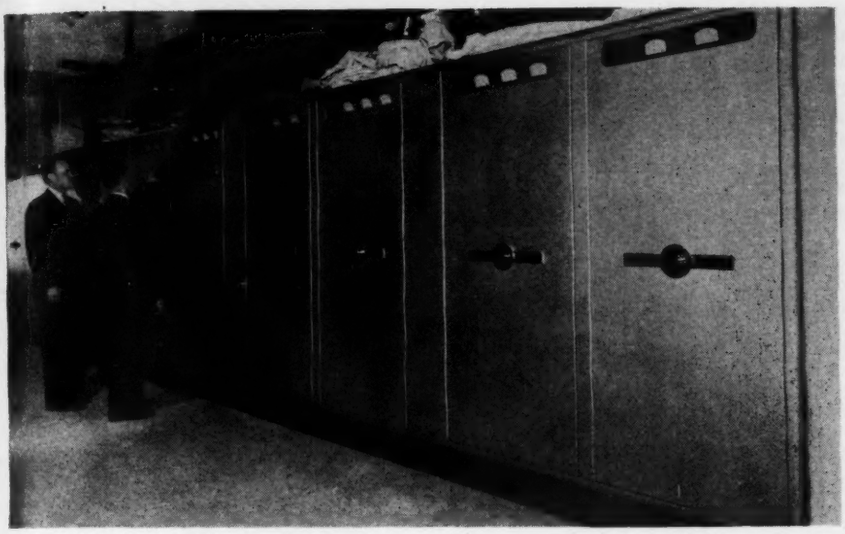
The details of the UHF television receivers operating between the frequencies of 480-920 megacycles that were developed in the CBS laboratories were disclosed. For color reception, a rotary disk carrying red (No. 25 Wratten), blue (Special No. 47 Wratten) and green (No. 57 Wratten) is rotated in front of the television screen. These receivers incorporate six single-tuned stages of if, the first and sixth being tuned to the center frequency, the second and third to the skirts of the desired band. In certain of these designs, a picture 15¼ x 21 in. was obtained using the standard projection technic. All these receivers are adapted for the reception of combined audio and video modulation on the same carrier and will receive both black and white and color.

490 MC TRANSMITTER

Norman H. Young
Federal Tel. Labs.

The final portion of this group of

MEETING DRAWS 7000

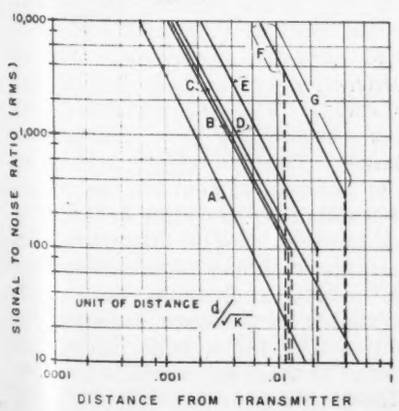


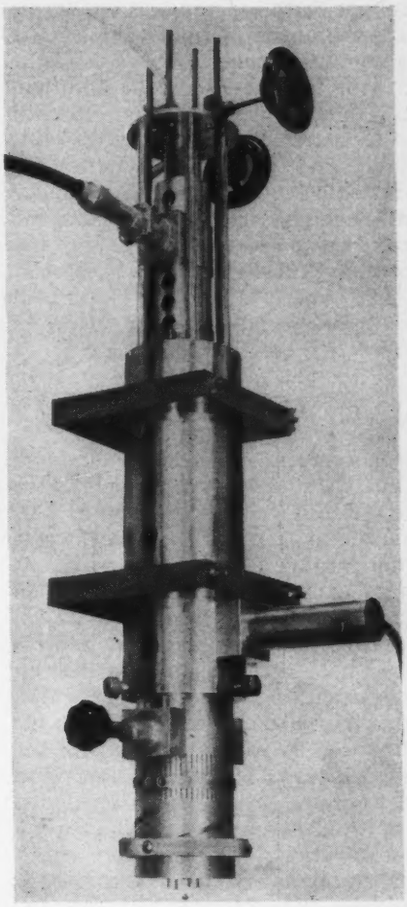
500 mc television transmitter in ten bays in the Chrysler tower (CBS)

papers described the details of the recently completed 490 mc television transmitter for use by CBS. This transmitter gives a continuous service output of a little under 1 kilowatt (peak power 1 kw), but because of the antenna gain possible at these frequencies, it was stated to have an effective output equivalent to 20 kilowatts. This transmitter was installed recently in the Chrysler Tower, and has already undergone many field coverage tests. The circuit used involves the use of UHF type 6C22 tubes in the four final stages of the rf amplifier stages and the two final stages of the video frequency amplifier. Although the development pioneered in many new fields in order to provide for the features required in this service, the transmitter was found to be capable of providing satisfactory signals even beyond the expectations of the CBS engineers.

A conventional sequence of crystal oscillator and frequency multipliers is used in the radio-frequency section. The video-frequency section is unusual chiefly in the use of direct-current coupling between amplifier stages, thus making the use of direct-current restoring circuits unnecessary. It can be modulated uniformly between direct current and 10 megacycles. The final radio-frequency amplifier is grid modulated, and the low plate resistance of the tube aids greatly in securing adequate bandwidth in the output radio-frequency current.

Signal to noise ratios for sound transmissions: A=amplitude modulated pulses; B=width modulated pulses (symmetrical); C=width modulated pulses (dissymmetrical); D=standard amplitude modulation; E=pulsed freq. modulation (fd=150 kc); F=pulsed freq. modulation (fd=1200 kc); G=standard freq. modulation (fd=150 kc)





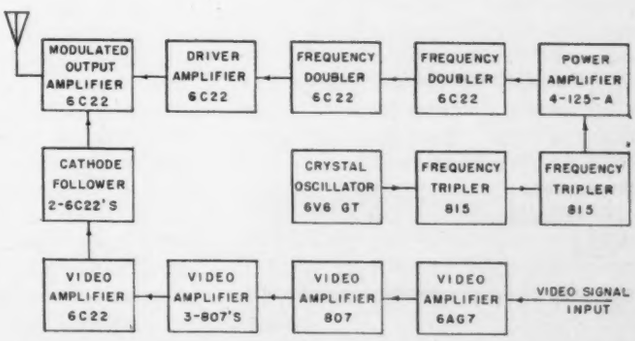
Coaxial amplifier at 500 mc (Federal incorporating the 6C22 tube in its structure

PROJECTION KINESCOPE

L. E. Swedlund
RCA Victor Division, Harrison, N. J.

This paper reviewed the development of cathode-ray tubes suitable for home projection types of television receivers. In addition to the reflective optics system, the outstanding gain in light output and improved contrast was obtained by applying an electron transparent film of aluminum to the back of the fluorescent screen. Other improvements which have been found with this screen process have been the reduction of secondary emission difficulties and the elimination of ion spots.

The fluorescent material on the inside face of the cathode ray tube screen is coated with an extremely thin (5×10^{-6} cm to 10^{-5} cm) continuous film of a conductor, deposited over an intermediate layer of an organic compound which provides a better base for the metallizing. As



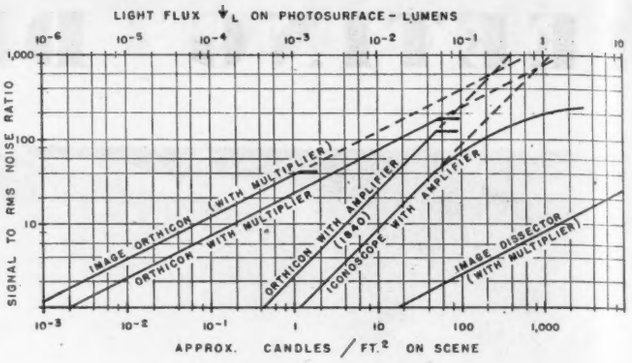
Block diagram of CBS transmitter using the Federal 6C22 tube

shown in the figure, the reduction in the beam power transmitted, is negligible at the beam voltages of 20 to 30 kilovolts usually applied to these tubes. The efficiency of a tube with the aluminized coating is approximately double that of the unmetalized tube as far as the light output is concerned. In addition, the reduction of the usual effect of stray electrons in reducing the contrast and the gain in efficiency caused by the greater controlability of secondary emission increases the contrast to several times that of the ordinary tube.

TELEVISION SYSTEM CHARACTERISTICS

O. H. Schade
RCA Victor Division, Harrison, N. J.

The second portion of the television symposium disclosed details of the RCA television development program. This paper gave a basic survey of the whole television system insofar as performance standards can be established, based on the optical capabilities of vision and certain psychological aspects that have an important bearing on television viewing. In particular, this paper compared the effects introduced by various portions of the system that limits contrast and definition. These items included the limitations of the camera, the pickup tubes, transmission channels, and several factors in the reception portion of the system. When these effects are combined in curves, they show that the capabilities inherent with the 525-line system have not been reached with present equipment, and also indicated where in the system development is most needed.


LIGHT FLUX ΦL ON PHOTOSURFACE - LUMENS
SIGNAL TO RMS NOISE RATIO
APPROX. CANDLES / FT.² ON SCENE
IMAGE ORTHICON (WITH MULTIPLIER)
ORTHICON WITH MULTIPLIER
ORTHICON WITH AMPLIFIER (1940)
ICONOSCOPE WITH AMPLIFIER
IMAGE DISSECTOR (WITH MULTIPLIER)

Comparison of S/N characteristics of typical tele pickup tubes

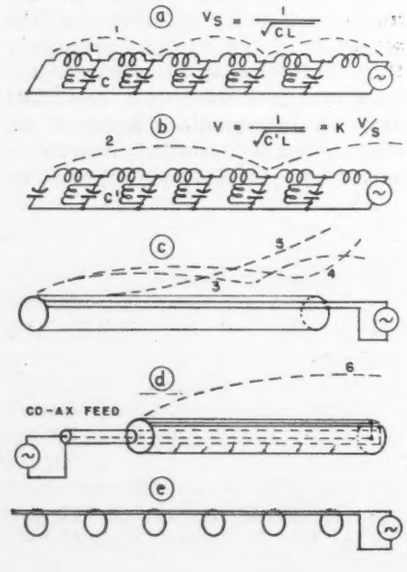
ANTENNA DESIGN

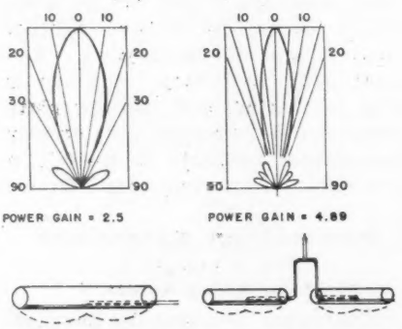
FM ANTENNA

Andrew Alford, Consulting Engineer

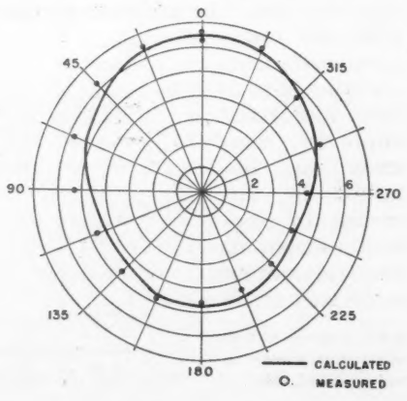
The antenna described consisted of a vertical cylinder with a slot approximately 3 in. wide running parallel to the axis. A co-axial line feeds the antenna, the outer conductor being connected to one side of the slot and the inner to the other. The slot forms a capacity while the cylinder forms an inductance in parallel with it. The entire cylinder may be thought of as a transmission line with a series of inductances and capacities in parallel running from one end to the other. By properly proportioning the diameter of the cylinder to its length the phase variation of the currents along the cylinder (it is slightly over one wavelength long) can be reduced almost to zero. In this way the entire length of the cylinder radiates in phase.

Dotted lines shown phase of currents in FM antenna. Changing width of slot, hence shunt capacity changes propagation along artificial system from a to b. Further changes shown at c. Dotted line 5 is an extreme result. By using the relations of inductance and capacity which produce 4 c and shortening the cylinder 6 d results





Radiation patterns of cylindrical antennas, center fed, split (above) and end fed (below)



BROADSIDE ARRAYS

John Ruze
Evans Signal Laboratory, Belmar, N. J.

The various factors considered in the design of broadside arrays were discussed with particular reference to radar antennas as used on the SCR-270 and the AN/CPX-1. The effect on band width as determined by pattern deterioration was mentioned. Mutual impedance between antenna elements and means of accomplishing the desired current and phase distribution were detailed. Various methods of lobing the broadside arrays with magnitudes of secondary lobes, and band widths were discussed.

BEAM-SHAPING METHODS

L. C. Van Atta
Radiation Laboratories, MIT

This paper dealt with the control of phase front to predetermine all lobe shapes, the conservation of power, and to prevent ground reflection. The angular width of an optical searchlight beam is determined by the extended light source placed at the focal point of the paraboloid reflector, and by inaccuracies in the reflector shape. The beam width of a microwave paraboloid antenna, however, is due to diffraction of the radiation at the aperture. The paraboloid will focus a beam only for a limited distance. The focusing property of the antenna system can be modified either by providing an extended antenna feed or distorting the paraboloid shape. Experimental and theoretical approaches were made available to antenna designers in this paper for a wide variety of beam shapes for special application.

BROAD BAND ANTENNAS

Andrew Alford, J. D. Kraus, A. Dorne and J. Christensen
Radio Research Laboratories
Harvard University

Methods have been developed to obtain broad-band antenna operation with low standing-wave ratio for frequency ranges used in radar, particularly those wide-band antennas for anti-jamming work. The description of the methods includes directional antennas, antennas with circular polarization, slot antennas, non-directional antennas, and also direction finders giving instantaneous visual presentation of direction for the same frequency. The DF was obtained by the rotation of a capacitor controlled by a selsyn motor. These direction finders are usable over wide frequency ranges without any antenna adjustment and have a pickup sensitivity comparable to or exceeding that of a half-wave dipole. Examples of homing devices for use on airplanes were given.

AIRCRAFT-ANTENNA MEASUREMENT

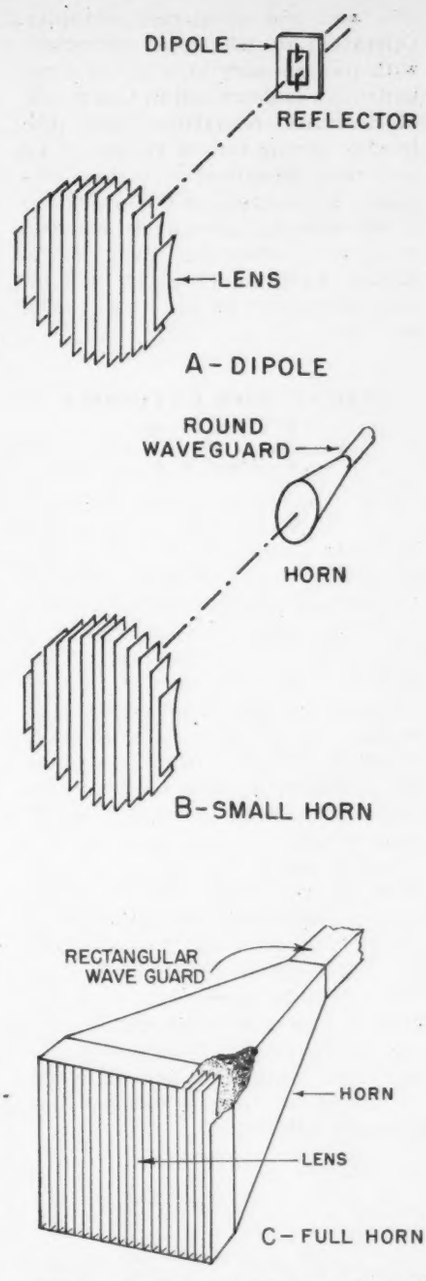
George Sinclair, E. W. Vaughan and Edward C. Jordan
Ohio State University Foundation, Columbus, Ohio

Although antenna models have been used for many years in studying radiation patterns, the measurements were severely limited as to frequency and type of antenna. It was shown how the technic may be extended to cover a very wide frequency range and a wide variety of antennas. Particular application to the study of aircraft antenna patterns were cited. The utility of models in studying special properties of antennas, such as polarization errors of direction finders, propeller-modulation effects, ellipticity of polarization, etc., were discussed. This paper gave the conditions for validity of scale models and the factors to be used. It described the type of apparatus necessary for model antenna measurement.

METAL-LENS ANTENNAS

W. E. Kock
Bell Telephone Laboratories, Inc., New York, N. Y.

A new type of antenna was described which utilized the optical properties of radio waves. It consists of a number of conducting plates of proper shape and spacing and is, in effect, a lens whose focusing action is due to the high phase velocity of a wave passing between the plates. Its field of usefulness extends from very short waves up to wavelengths of perhaps 5 meters or more. Application of this type antenna is recognized in repeater station work. This is due to the fact that it has superior shielding between the transmitter and receiver by the use of horn antennas with lenses. The energy from this type antenna is vertically polarized. Demonstrations were given to show the effects of this polarization. Illustrated is the metal lens applied to a dipole reflector and a round wave guide horn. The paper discusses the properties of this antenna, methods of construction, and application.



Metal-lens applied to focus beams from dipoles, and waveguides

VACUUM TUBES

600 MC TRIODE

S. Frankel, J. Glauber and J. J. Wallenstein
Federal Telecommunications Laboratory, N. Y.

This paper described the L600E and the 6C22 type tubes in operation at 600 mc. A detailed description of the tube structures which included design considerations of the electrodes, operating conditions and static characteristics was given. The high peak emission currents necessary for 25 kw operation were satisfied by thorium filaments. Transit time was reduced by using high anode potentials. Effects of space charge in output limitation were noted. Type L600E was not satisfactory for CW work, therefore, the 6C22 was developed. This tube has a power gain of 2.6 as an amplifier in grounded grid circuits. The 6C22 has been used at 850 mc with 10% efficiency. Methods of testing and using these tubes as oscillators, amplifiers, and frequency multipliers were given. The L600E was known as the Pulsitron.

REFLEX OSCILLATORS

J. O. McNally and W. G. Shepherd,
Bell Telephone Laboratories, Inc., New York, N. Y.

Electronic tuning of reflex oscillators by variation of the repeller voltage was discussed. A number of problems encountered in the design of reflex oscillators for military applications were also taken up and a method of thermally tuning the cathode was described.

MICROWAVE TRIODES

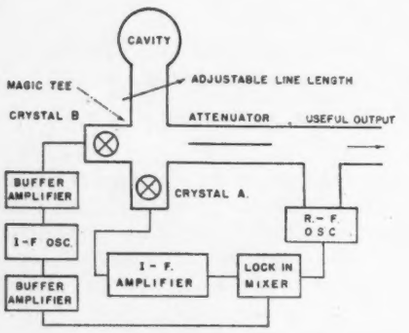
Everitt M. Goodell
Sylvania Electric Products, Inc., Emporium, Pa.

A new series of planar-grid triodes has been developed. They are adaptable to both pulse and CW operation at microwave and lower frequencies. They have been made possible by better jigging and closer tolerance of parts to reduce the internal tube capacity. Disc seal type tubes eliminate lead lengths because they may be plugged directly into a concentric line. Tubes to be used as oscillators have a probe built into the structure which gives sufficient feedback. Operation as high as 3000 mc is possible. The 2C36 tube was described in operation up to 3000 mc with 100 w output when the duty cycle was less than 2%.

MICROWAVE STABILIZATION

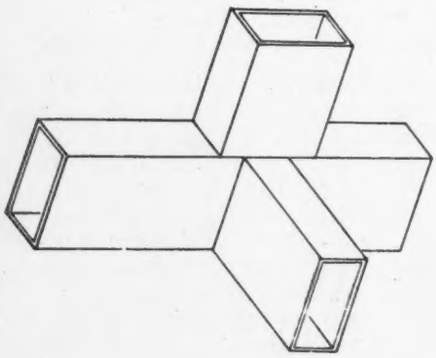
R. V. Pound
Radiation Laboratory, M.I.T.

The increasing use of microwave frequencies necessitates the design of highly stabilized oscillators for laboratory and communication use. Relative frequency can be maintained to better than one part in 10^8 by methods described in this paper. Energy from an rf oscillator is fed through an attenuator into a "Magic Tee". The impedance looking into any arm of this unit is the same. The "Magic Tee" has one arm connected to the resonant cavity which establishes the absolute frequency stability. Crystal detectors in the "Magic Tee" have their voltages amplified, which then are applied to correct the oscillator frequency. One method fed the frequency error back through the "Magic Tee," microwave discriminator, etc., to correct the relative frequency. This was accomplished by application of the error voltages to the oscillator reflector plates. High fidelity FM with deviations of the order of $f/140$ about the stabilized frequency is possible.



Stabilized microwave system

"Magic Tee" network



HF POWER FOR CW

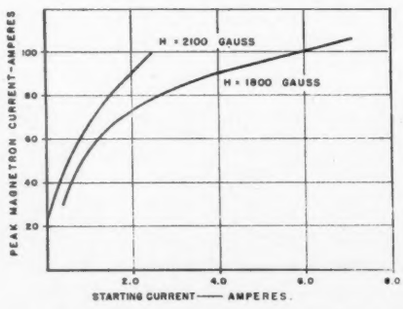
W. G. Dow, J. N. Dyer, W. W. Salisbury and E. A. Yunker
Radio Research Laboratory, Harvard University

Radar jamming equipment required ruggedness, reliability, long life and not frequency stability. Operation of this type equipment with its necessary high power components was described in this paper. Magnetrons, resnatrons and disc triodes having tuning ranges of 1.5 to 1 were described in various circuits. Magnetrons in CW operation at 500-4000 mc developed 1000-2000 w at 60% efficiency. Equipments having wave-guides 22 in. x 6 in. mounted on a 10 ton truck were described.

MAGNETRON CATHODES

C. L. Shackelford
Westinghouse Electric Corp., Bloomfield, N. J.

Since the electron back bombardment of the cathode imposes undesirable limitations on a duty cycle and maximum average power of magnetrons the possibilities of cold secondary emission cathodes was investigated. Oscillations to initiate back bombardment were started by a heated emitter so arranged as to permit the transfer of the main emission to an unheated surface. Many materials were used as secondary emitters including beryllium, aluminum, nickel-barium alloy, thorium and silver magnesium alloy. Many factors were studied: first, at the Radiation Laboratory, M.I.T., and later at the Westinghouse Lamp division research dept. These included investigations of activation processes, methods of cooling, measurement of surface emission and peak emission currents obtainable for various voltages and states of activation.

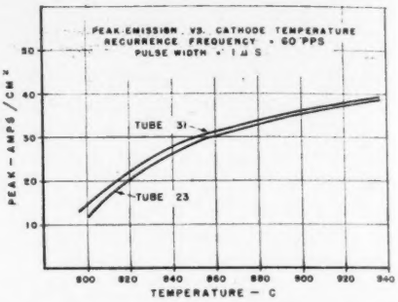


Secondary emission cathode current

MAGNETRON CATHODES

M. A. Pomerantz, Bartol Research Foundation of the Franklin Institute, Swarthmore, Pa.

A description was given of some of the characteristics of oxide cathodes used in magnetrons and capable of heavy current emissions per sq. cm. of surface. Other matters touched upon were decay of emission with time, cathode and anode sparking, the role of back bombardment and secondary emission and the use of thoria cathodes. M. A. Pomerantz pointed out that the success of the war developed magnetrons of high power is based on the possibility of high current emissions from small cathode surfaces.


PEAK EMISSION VS. CATHODE TEMPERATURE
RECURRENCE FREQUENCY = 60 PPS
PULSE WIDTH = 1 μ S
TUBE 31
TUBE 23
PEAK - AMPS / CM²
TEMPERATURE — C

Influence of cathode temperature on emission

HIGH-VOLTAGE RECTIFIER

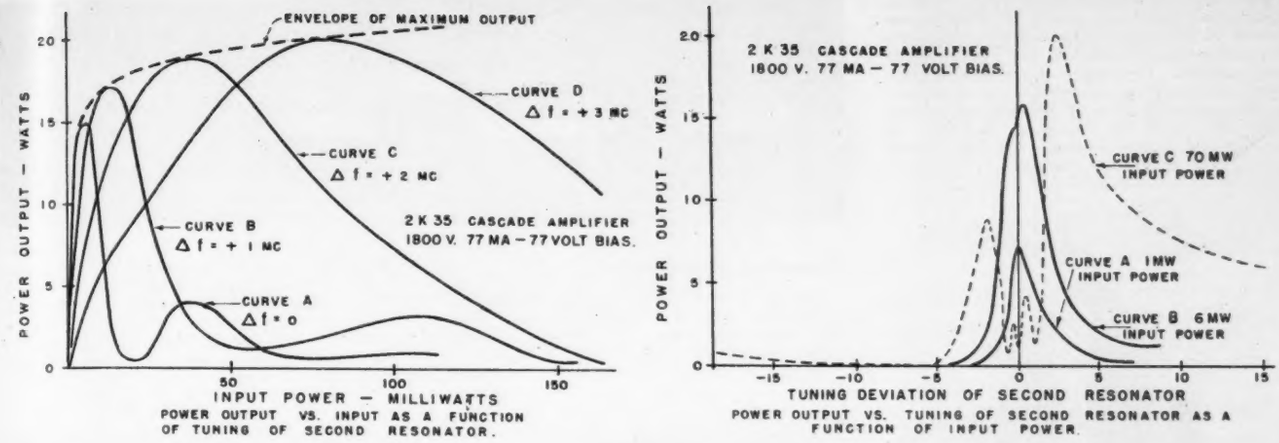
George Baker
National Union Radio Corp., Newark, N. J.

The new factors in the design of a small size, low current rectifier tube for operation at several kv were considered. Electro-static forces of 15 grams against the filament by the high anode potential limited the filament to tungsten wire. The filament was mounted slack, and was also bowed to withstand this force. It was also discovered that the glass assumed a potential, hence proper shaping of the anode was necessary. This minimized the cold field emission which, if uncontrolled, would result in large reverse current when high velocity electrons struck the glass. Minimum dielectric losses, anode shape, a highly polished anode, and filament design were the factors which made this tube successful.

MINIATURE TUBES FOR FM

R. M. Cohen, R. C. Fortin and A. M. Morris
RCA Victor Division, Harrison, N. J.

The use of a new miniature converter tube and a new miniature radio frequency amplifier tube in FM receivers covering the 88 to 108 mc. band was described. The tubes described were the 6BA6, remote cutoff pentode having less grid-plate capacitance than the 6SG7. The other was the 6BE6 which is similar to the 6SA7 except that the oscillator Gm is twice that of the latter tube. Data covering construction and performance including circuit constants, stage gain, overall gain, signal-to-noise ratios, image rejection and oscillator frequency trends were presented. The authors pointed out the following technics necessary at 100 mc FM.


ENVELOPE OF MAXIMUM OUTPUT
CURVE D
Δ f = + 3 MC
CURVE C
Δ f = + 2 MC
CURVE B
Δ f = + 1 MC
CURVE A
Δ f = 0
2 K 35 CASCADE AMPLIFIER
1800 V. 77 MA — 77 VOLT BIAS.
POWER OUTPUT — WATTS
INPUT POWER — MILLIWATTS
POWER OUTPUT VS. INPUT AS A FUNCTION OF TUNING OF SECOND RESONATOR.
2 K 35 CASCADE AMPLIFIER
1800 V. 77 MA — 77 VOLT BIAS.
CURVE C 70 MW INPUT POWER
CURVE A 1MW INPUT POWER
CURVE B 6MW INPUT POWER
TUNING DEVIATION OF SECOND RESONATOR
POWER OUTPUT VS. TUNING OF SECOND RESONATOR AS A FUNCTION OF INPUT POWER.

Effect of tuning variations in second resonator cavity on power amplification of cascade klystron. Maximum results occur with slight detuning

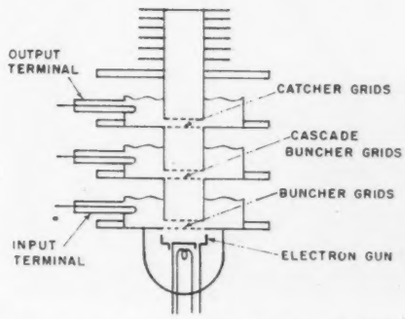
When the oscillator voltage is strong at the signal grid, tuning varied the bias on the tube. It is therefore advisable to ground the signal grid in alignment procedure. In the converter stage the oscillator frequency was set above the signal frequency.

CASCADED KLYSTRONS

E. G. Levinthal,
Sperry Gyroscope, Inc.,
Garden City, N. Y.

The theory of operation of the three-resonator Klystron amplifier was given for the case of small signal operation. An analogy between the operation of a cascade amplifier and velocity modulation by a saw-tooth voltage was demonstrated. Some calculated values of two parameters were given which yield theoretically efficiencies in the neighborhood of 74%. These amplifiers are finding extended use in the design of microwave equipment.

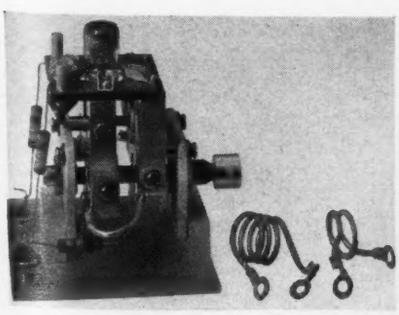
(*Continued on page* 71)



Schematic of triple cavity klystron amplifier

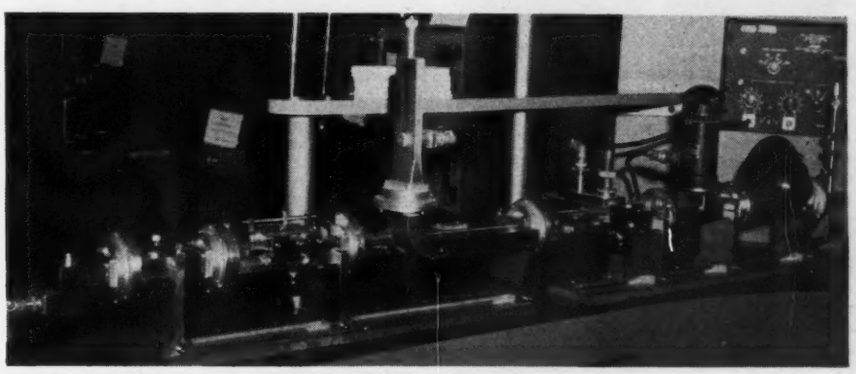
WHAT'S NEW AT THE IRE ENGINEERING EXHIBIT

• It was a tough job pushing one's way around the exhibits. Which will give a fair idea of the interest the IRE manufacturer's exhibition held for the 7000-odd Institute members and guests who jammed the exhibits and the aisles. The exhibition, largest engineering show ever held, had grown until it occupied most of two floors in the Hotel Astor, contained the parts, completed components, test equipment—even finished and in some cases operating, transmitters—and a host of other new and not so new things. Equipment having to do with microwaves, with various methods of sound recording and with the use of oscillographs for the very many purposes to which these versatile instruments now are being put, appeared to attract the greatest attention. There was plenty else that was new. Among such items were these:



VHF Oscillator

A vhf oscillator exhibited by the Allen D. Cardwell Mfg. Corp., 81 Prospect St., Brooklyn, N. Y., covers three amateur bands in the range from 100 to 1,000 mc. by use of replaceable self-supporting coils. The oscillator is essentially a conventional coil-condenser tank circuit using a 6F4 acorn tube. Due to rigid construction the frequency stability is said to be excellent. The oscillator may be used to drive a lighthouse tube as power amplifier.—Electronic Industries



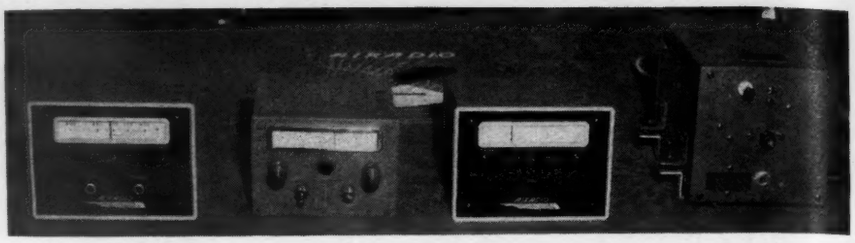
Microline Instruments

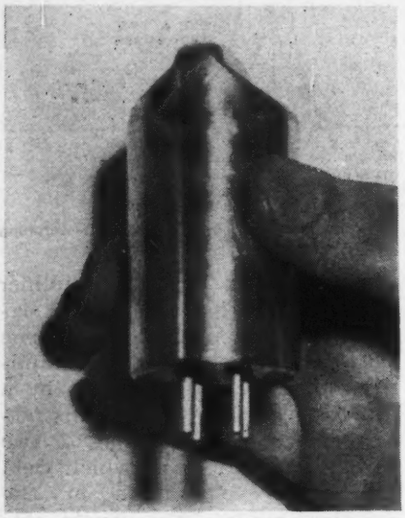
A series of Microline instruments in operation as a microwave test bench were displayed by the Sperry Gyroscope Co., Great Neck, N. Y. With the help of these instruments, power-, frequency- and impedance measurements may be carried out. Some of the instruments shown were: Cavity-, coaxial- and broadband frequency meters, various calibrated and uncalibrated variable attenuators, impedance meters, transformers and line terminations.—Electronic Industries

Audio Frequency Meter

A frequency meter capable of measuring the frequency of ac voltages over the entire af spectrum independent of wave form has been brought out by Communications Measurements Laboratory, 120 Greenwich St.,

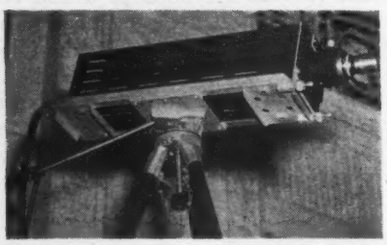
New York. In conjunction with a "photo-beam converter" the model 1800 meter becomes an electronic tachometer for measuring the speed of rotating and reciprocating mechanisms. Frequency of positive or negative pulses from a fraction of a microsecond to more than 50 microseconds duration also may be measured, accuracy is ±0.5% full scale cycles. The frequency range, 10 to 20,000 cps in six ranges.—Electronic Industries





Rotary Converter

The Dynectron rotary converter manufactured by the Ohio Tool Co., Cleveland 11, Ohio, is designed to replace the standard vibrator in automobile radios. An evacuated mercury cell acting as a commutator is the heart of the new converter, for which reduced electrical and mechanical noise levels, much longer life and constant maximum efficiency is claimed.—Electronic Industries



Television Camera

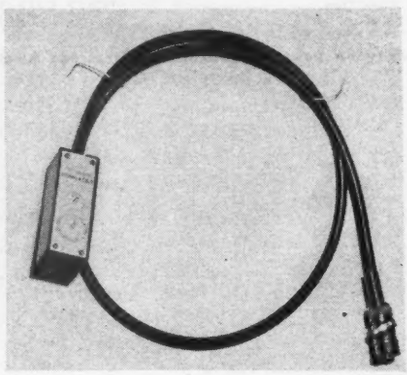
The Electronic Division of Remington Rand, Inc., Middletown, Conn., exhibited the "Vericon" television pick-up system, which is now available for commercial applications. Its weight of 40 lb. makes it easily portable. Two camera types are available, and are interchangeable: The standard Vericon camera, using the pick-up tube model 212 for normal lighting conditions, and the image Vericon—a highly sensitive pick-up tube—for very low lighting conditions. Provisions are made in the camera by electronically controlled adjustment of the diaphragm opening to maintain automatically optimum contrast under varying lighting conditions.—Electronic Industries

Pulse Timer

R. W. Cramer Co., Inc., Centerbrook, Conn., has a newly developed pulse-timer unit that will deliver electrical impulses of a definite duration at the end of regularly spaced and successive time intervals. The time interval may be adjusted over a wide range.—Electronic Industries

Aviation Receiver

An aid to private flying is a 2-way communication system brought out by Airadio Inc., Stamford, Conn. Weight of the complete equipment, consisting of receiver, transmitter and powersupply, is less than 11 lb. The receiver covers the broadcast band and the radio range band of 195 to 420 kc has a tuned rf stage and slide rule dial. The transmitter comprising crystal oscillator and power amplifier can be had for any frequency between 2 and 7 mc.—Electronic Industries



HF Probe

A new type probe for measuring voltages in VHF circuits is being made by Alfred W. Barber Laboratories, 34-04 Francis Lewis Blvd., Flushing, N. Y. Input capacity is 0.5 mmfd. Used with a Barber VM-27 vacuum tube voltmeter, no multiplier is required to measure voltages up to 1000 v.—Electronic Industries

Antenna Towers

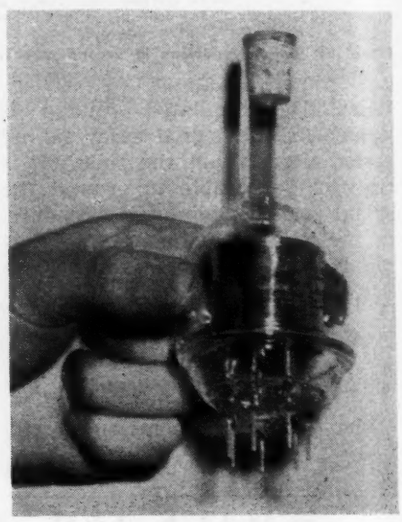
Harco Tower, Inc., 1180 E. Broad St., Elizabeth 4, N. J., produces "Easy to Erect" masts and towers. The only equipment needed for erection of its 4 ft. triangular tower is a piece of rope and a wrench. After erection of a 6 ft. section on the ground, by climbing the ladder on the inside the succeeding 6 ft. section may be erected.—Electronic Industries

Audio Transformers

A precision line of audio transformers covering mixing, bridging, input, interstage, plate to line, line to speaker and output functions has been designed by American Transformer Co., 178 Emmet St., Newark 5, N. J. These units have a frequency response from 30 to 15,000 cps, plus or minus ½ db. Characteristics are obtained by careful design and do not use shunt resistors.—Electronics Industries

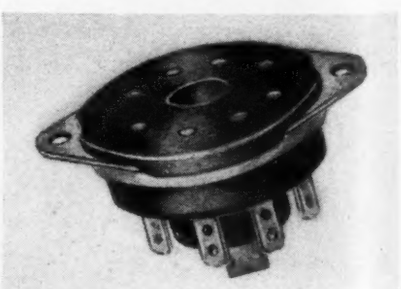
Frequency-Insensitive Resistors

Corning Glass Works, Corning, N. Y., exhibited precision resistors, which were used in radar equipment during the war. "Pyrex" brand resistors are designed to be relatively independent of frequency over a wide frequency range because their resistive elements are extremely thin—a metallic film less than 1/100,000 in. thick. Temperature coefficients are small and approximately constant between 25° and 150° C. Test resistors subjected to maximum power ratings for 1,000 hours showed a resistance deterioration of less than 0.5%.—Electronic Industries



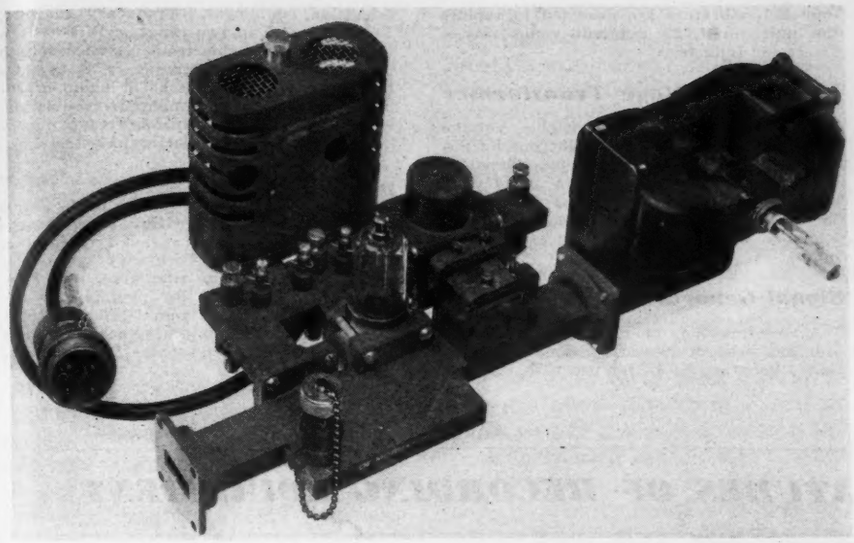
Ionization Gage

Ruggedness and high sensitivity characterize the type 507 ionization gage exhibited by the National Research Corp., Boston 15, Mass. The gage has a plate constructed of nickel, a tungsten filament and tungsten grid. Characteristics are: Max. operating pressure air is 1 micron Hg; the sensitivity at 5 ma emission current is 100 microamperes per micron; the max. emission current is 25 ma. It is designed to be used with Universal vacuum seal, type 1304 and gage controls, types 706 and 707.—Electronic Industries



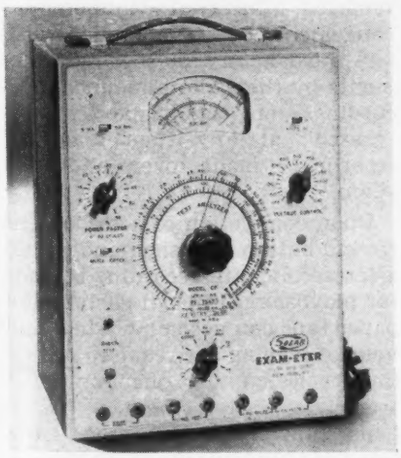
Tube Socket

The new Plexicon tube socket, developed jointly by Cinch Mfg. Co., Chicago, Ill., and Erie Resistor Corp., Erie, Pa., will be made to provide capacitive by-passing for any desired combination of tube pins. Maximum capacity of any pin by-pass is 1,000 mmfd. Silvered ceramic capacitors are used. Capacitive coupling effect between by-passed tube pin and adjacent pins is reduced by the shielding effect of outer elements of the capacitor.—Electronic Industries



Commercial Radar

De Mornay-Budd, Inc., 475 Grand Concourse, New York 5, has developed a packaged rf radar assembly designed for commercial and military radar apparatus. The complete rf radar assembly operates on 9000 mc The unit shown consists of the following components: A magnetron of 20 kw. output; one 1B35 ATR tube; one 1B24 TR tube; 2K25 local oscillator tubes; 1N21 crystals; 20 db narrow band directional coupler. A beacon cavity beacon crystal mount are optional in the event that beacon operation is desired—Electronic Industries



Capacitor Analyzer

A new test unit for checking intermittent, open-circuited and short-circuited capacitors of all types without unsoldering leads has been designed by Solar Mfg. Co., 285 Madison Ave., New York 17, N. Y. Capacitor values from 10 to 2,000 mfd. and resistors from 100 ohms to 7.5 megohms can be measured. Power factor, leakage current and insulation resistance checks are quickly made. The unit contains a vacuum tube voltmeter.—Electronic Industries

Loop Antenna

DX Radio Products Co., 1200 N. Claremont Ave., Chicago 22, Ill., has developed a pancake loop antenna which has been designed for high "Q". Loops can be wound with any size wire between No. 20 to No. 38, or any size Litz. No impregnation is necessary.—Electronic Industries

Communications Receiver

Soon available in the medium price field will be the model S-40 9-tube communications receiver to be manufactured by the Hallicrafter Co., Chicago 16, Ill. The receiver provides such as: separate bandspread tuning, covering the range 540 kc to 44 mc, in 4 bands, has permeability adjusted coils, automatic noise limiter, tone control and stand-by switch. Available for ac only.—Electronic Industries

Synchronizing Generator

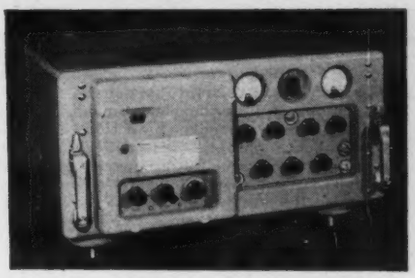
Telequip Radio Co., 1901 S. Washtenaw Ave., Chicago 8, Ill., exhibited a television synchronizing generator consisting of two regulated power supplies, timer unit, shaper unit and monitoring oscilloscope. The standard FCC-RMA signal is produced by the equipment. The timer unit uses Eccles-Jordan multivibrators for the production of timer signals. Controls are provided for the adjustment of width and position of various pulses in the shaper unit. A 7-in. cathode ray tube is part of the monitoring oscilloscope.—Electronic Industries

Distortion Analyzer

The new model 330B Distortion Analyzer developed by Hewlett-Packard Co., Palo Alto, Cal., will measure distortion at any frequency between 20 and 20,000 cps. Noise measurements can be made of voltages as low as 100 microvolts. A linear rf detector allows measurements directly from a modulated rf carrier.—Electronic Industries

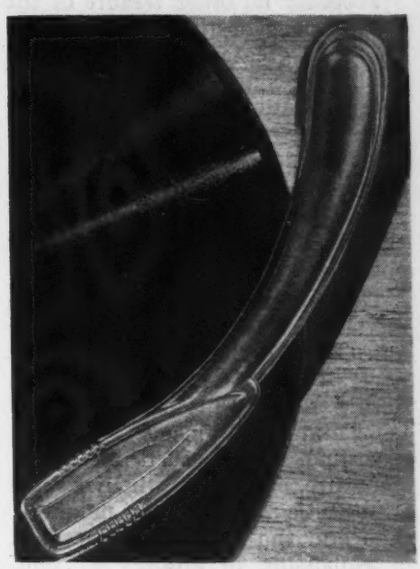
Audio Oscillator

With a frequency coverage of 20 to 20,000 cps, the new AF oscillator designed by Hewlett-Packard Co., Palo Alto, Cal., has less than 1% distortion at 3 w output. Under normal temperature conditions the frequency stability is better than plus or minus 2%. Line voltage variations under 10% will not change output frequency.—Electronic Industries



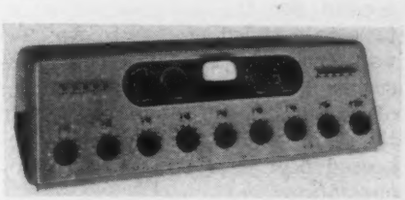
RDZ Receiving Equipment

Currently being supplied to the Navy Department is a recently designed vhf receiver being made by the National Co., Inc., Malden, Mass. Primarily intended for the reception of voice transmissions the receiver also permits use of external equipment for wide band scanning and video presentation. Crystal units enclosed in thermostatically enclosed ovens assure stability of the various frequency channels. The receiver incorporates automatic tuning by the use of an "Auto-Tune" unit.—Electronic Industries



"Glider" Pick-Up

To the field of low-priced light-weight pickups Shure Brothers, 309 W. Jackson Blvd., Chicago, Ill., adds the "Glider" pickup which has a lever-type cartridge and low-mass tone arm. No springs or counterweights are used. The output voltage is 1.6. The unit is designed for low needle impedance, high needle compliance and a resonance-free tone arm.—Electronic Industries



Control Console

By the use of three-position lever-type switches operational controls have been reduced to a minimum in the new studio control console designed by Raytheon Mfg. Co., Broadcast Equipment Div., 7517 N. Clark St., Chicago 26, Ill. This unit includes seven built-in pre-amplifiers, nine mixer positions and control of fourteen remote lines. Frequency response is 2 db from 30 to 15,000 cps, with distortion of less than 1%—50 to 10,000 cps.—Electronic Industries

Vacuum Capacitors

The Amperex Electronic Corp., 26 Washington St., Brooklyn, N. Y., exhibited the VC-50 line of vacuum capacitors recommended for use in the electro-medical field and for high-frequency induction and dielectric heating applications. High current rating in small space, high capacity stability at high current levels, low losses and large area glass-to-metal seals are some of their characteristics.—Electronic Industries

Vibrator Converters

A line of four radio vibrators to service 95% of all car radios now on the road will soon be available according to Electronic Laboratories, Inc., Indianapolis, Ind. These four E-L vibrators are designed to replace the units in 1,122 different radio sets.—Electronic Industries

Variable Voltage Transformer

Three new models of variable voltage transformers have been brought out by Superior Electric Co., Bristol, Conn. Type 20, with a maximum output of 3a at 135v, is less than 4 in. in its greatest dimensions. Types 11-26 and 12-26 are engineered for minimum size and are fuzed.—Electronic Industries

Signal Generator

A new frequency modulated signal generator has been developed by Boonton Radio Corp., Boonton, N. J., for use with FM and television equipment. Frequency range is 54 to 218 mc., in two ranges. Rf output is continuously variable from 0.1 microvolt to 0.2 volts. Deviation frequency is adjustable between 0 and 250 kc at audio or supersonic frequencies. Amplitude modulation, with or without simultaneous freqency modulation, is available.—Electronic Industries

Dummy Tubes

A miniature socket wiring plug was exhibited by the Star Expansion Products Co., 147 Cedar St., New York. The plugs are cast in one piece of zinc alloy and have stainless steel pins. By plugging in the dummy instead of the actual tube the accurate alignment of miniature socket contacts during wiring is facilitated.—Electronic Industries

ENGINEERING FEATURES OF RECORDING EQUIPMENT

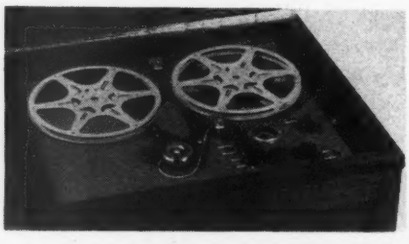
Probably no other feature of the Conventions of the AIEE and the IRE held greater interest than did the features and possibilities of the several methods now available for both home recording and transcriptions of radio program material.

The interest expressed was based on many new fields of activity and the higher levels of quality now obtainable.

The characteristics of the various methods of home recording available were disclosed in numerous papers, displays and demonstrations during the conventions. The advantages and limitations of the various recording media, such as round steel wire, paper tape which carried a magnetic material, steel magnetic tape and the mechanical methods of embossing in grooves on film, were all disclosed. It became evident that the quality necessary for the satisfactory reproduction of high quality radio programs could be obtained with any of these methods, provided that the wire or tape was moved at a sufficiently high speed. Recording speeds ranged from a little less than one foot per second for the magnetized paper tape to a speed of four to five feet per second for high quality transscription work. Speeds of the order of one foot per second, used with the tape recorders and with embossed film gave remarkable demonstrations.

One arrangement was described in a paper by Dr. S. J. Begun of Brush Laboratories, Cleveland, using a magnetized paper tape at a speed of one foot per second. The Recordograph instrument* using embossed film was also demonstrated. A wire type recorder by the Armour Research Foundation utilized speeds of from two to five feet per second. A German built magnetic tape recorder was both displayed and demonstrated during the IRE Convention. This instrument used iron oxide impregnated tape ¼ in. wide and 0.5 mils thick. The magnetic material was a dark maroon color and was apparently completely dispersed throughout the cross section of the strip. The tape developed by the Brush Laboratories consists of a blue-black coating of magnetic material on a paper strip ¼ in. wide and is supplied wound on regular 8 mm. film reels.

The paper tape can be edited simply by tearing out any undesired sections and splicing with Scotch tape adhesive. No break is detectable on playback. This assists the user to compile a home library of any type of recordings "tailor made" to his personal taste. For example, an "album" of popular songs can be compiled on one uninterrupted reel, a complete half-hour radio program can be recorded with commercials and other undesired portions neatly and undetectably removed, a series of symphonic arrangements can be compiled without introductory blurbs and comments by the radio announcer. Recordings on the tape can be "erased" at any time and new recordings made over and over again.



Above, new Brush magnetically coated paper tape recorder. Below, recorder using plated non-ferrous wire instead of stainless steel

Upon completion of a record, the rewind button is pushed and within a few seconds the recording is ready for playback. Although each reel of paper tape can accommodate a half hour of playing the required rewind time is well under one minute. It was claimed that the new coated paper tape can be produced at less cost than previous magnetic recording mediums, such as wire and metal tape.

The Brush Laboratories also perfected another wire recording medium: a magnetic layer deposited on the surface of a highly ductile metal base (such as brass). This coating is electroplated by a special process to give it the necessary magnetic properties for recording. Brush has perfected a means of plating this wire in such a way that exceptional uniformity and fidelity are obtainable. It was stated that the cost of this medium should be below that of the usual stainless steel wire.

The wire recorder was one of the

*"Multi-Channel Sound Recording on Film", Electronic Industries, April, '45, P. 92

most talked about systems during the convention inasmuch as close to thirty companies have been licensed to produce equipment using the ultrasonic biasing methods, developed by Armour. As is well known, this system uses a stainless steel wire about 0.004 in. in diameter.† The advantages claimed for magnetic wire recordings are: No needle scratch — low background noise level; no break in continuity as found with record changing; wipe off and re-use of wire; instantaneous play-back without processing; unlimited number of playbacks; extended recording time; excellent fidelity without elaborate precautions or special skills in recording; lightness, compactness, portability. In addition, any portion of a record can be erased and revised without harm to adjacent portions.

The method of recording introduced by Armour combines a fixed high frequency current with the audio signal, the high frequency component being in the order of 30 kilocycles. A series of minor hysteresis loops result. When the magnitude and frequency of the two currents are adjusted properly the final permanent value of magnetism in the wire is dependent only on the instantaneous value of the low frequency (audio) field, and is substantially linear through the origin, thus giving a straight line recording characteristic. The high frequency component does not appear in the final record. In this way all even harmonics are eliminated, and the full magnetic capabilities of the record medium are used. The quality of reproduction depends on the residual magnetization, coercive force, and energy product of the wire.

Wires that have been developed recently allow records of the same quality to be made at one-third the previously used speeds, and further improvements are very likely. The cost of a wire spool was asserted to be competitive with ordinary types of disc records having equal playing time.

The development on wire is still going on and improvements in this regard are still expected. Some work has progressed in several laboratories as in the matter of making measurements of the magnetic properties of tapes, wires and other magnetic recording materials. In a home recorder system demonstrated by the Armour Foundation, a speed of two to two and a half feet per second was utilized. At a latter speed the output was within 3 db between 80 and 8500 cycles and was down 5 db at the 65 cycle and 10,000 cycle points. The wire used had a strength of 3 lb. for a steady pull. In this regard the pull required to break the magnetic paper tape, (Brush) was stated to be 6 lb. steady pull. This is interesting in view of the fact that paper base tape might be considered to be extremely fragile.

During the week various details of wire recorder heads, magnetic characteristics and recording speed conditions were described. At a symposium on these subjects (AIEE) details of wire recording were outlined by D. W. Puxley of the General Electric Co., describing the wire recorded system using ultrasonic magnetic biasing. A new wire recorder head design was described by T. H. Long of the B. G. Conn, Ltd. These heads were developed to overcome the tendency for foreign material to accumulate across the working gap.

From the enthusiasm shown it is apparent that this field of development has an important place in many fields of application, the most notable being that of home recordings from the spoken words of members of the family, received programs of interest from the radio or re-recording from disc records. A long and imposing list of applications has been compiled where this equipment has served useful purposes.

†"Engineering Details of Magnetic Wire Recorder" by D. W. Pugsley, Electronic Industries for Jan. '44, p. 116

BRIEFING THE IRE WINTER TECHNICAL MEETING PAPERS

(*Continued from page 67*)

PROPAGATION

PROPAGATION IN OCEAN DUCTS

M. Katzin, R. W. Bauchman and W. Binnian
Naval Research Laboratories
Washington, D. C.

In order to check the effects on three and nine centimeter transmission of low level ducts formed in oceanic air, one way measurements between a ship and a shore station were made with antenna combinations of various heights. Meteorological measurements taken from both shore and ship were described and the conditions in duct height and strength were discussed. Meteorological and radio measurements inland were made and the effect of distance back from the shore on meteorological conditions and radio transmissions were described. Three centimeter radar observations were made during the latter part of the project and the variation of echo amplitude with range of ship target was measured. Analysis of radio and radar measurements was given.

SIX MM. WAVE PROPAGATION

G. E. Mueller
Bell Telephone Laboratories, Inc., New York

The effects of rainfall and atmospheric absorption on propagation of microwaves and the methods for measuring them were described. The attenuation of 3.2 centimeter waves is slight for moderate and light rainfalls. During a cloudburst, however, the attenuation may approach a value of 5 db per mile. A wavelength of 1.09 centimeters is appreciably attenuated even by a moderate rain. Losses at .62 centimeters reach a value of 42 db per mile in a cloudburst.

RAIN EFFECT ON MICROWAVES

S. D. Robertson and A. P. King
Bell Telephone Laboratories, Inc., New York

It was demonstrated that the drop size of rain influenced the attenuation of centimeter waves. In a heavy rainfall, four to ten db per mile loss has been experienced. Data showed a definite relationship between the rainfall and path loss compared with the time of precipitation. With a wavelength of 1.09 centimeters, an attenuation of .3 db/mm/hour was experienced as compared with a wavelength of 6 mm. having an attenuation of .6 db/mm/hour.

ATMOSPHERIC DUCTS IN PROPAGATION

J. E. Freehafer
Radiation Laboratories, MIT

Experience gained during the war has shown that strong fields, at frequencies greatly exceeding the penetration frequency of the iono-

sphere, often are observed at several times the horizon distance. Experimental and theoretical investigations in this country and in England indicate that these effects are associated with the presence of layers in the troposphere in which the vertical gradient of refractive index exceeds numerically the reciprocal of the earth's radius. Under these conditions a duct is formed which, for sufficiently high frequencies, both reduces the rate at which the field is attenuated with range and also disturbs the normal height gain effect. Experiments were described at which aircraft plotted signal strength, temperature, and humidity at various altitudes from the transmitters. It has been found that by means of the atmospheric ducts 75 centimeter transmissions have been heard at five times the horizon distance. A 200 mc radar indicated targets 1700 miles away from Bombay, India. These atmospheric ducts change with temperature and water vapor in the air.

SKY-WAVE PROPAGATION

J. H. Dellinger and Newbern Smith
National Bureau of Standards
Washington, D. C.

The pulse method of ionosphere measurement was developed for radar. It was extremely vital to predict the radio propagation characteristics in advance, in order that the best operating frequencies might be used. The major aspects of the worldwide radio propagation program developed during the war were described in this paper. Study of atmospheric radio noise, methods for calculating sky-wave field intensities, ionospheric-storm forecasting, effects of ionosphere on direction finder indication were important studies made by the Bureau of Standards. For their purposes the world was divided into three zones, based on geometric latitude. Data collected from the many field stations of the allied nations enabled accurate forecasting of ionosphere conditions three months in advance. Bureau of Standards bulletins are available without charge to anyone interested in this subject.

ARRIVAL OF MICROWAVES

W. M. Sharpless
Bell Telephone Laboratories, Inc., New York

This paper described the method of measuring the direction from which microwaves arrive at a given receiving site. These waves travel in curved lines caused by refraction of the earth's atmosphere. This work is extremely important in the design of radio relay link antennas. Data collected on two short optical paths using a wavelength of 3¼ centimeters was presented to illustrate the use of the method. Angles of arrival, as large as ½° above the true angle of elevation have been observed in the vertical plane, while no variation greater than ±1/10° has been found in the horizontal plane. More recent work using a lens type scanning antenna operated at a wavelength of 1.25 centimeters revealed that at times as many as four distinct transmission paths were present simultaneously on a 12.6 mile circuit. Simultaneous meteorological soundings were made near both terminals of the circuit. It was observed that hot nights had caused the greatest errors in measurement. There was notably less fading on wave lengths of 30 centimeters and less effect by the atmosphere, than on shorter wave lengths. All measurement work was done by CW modulation.

TELEMETERING AND RECORDING

RADIO TELEMETERING

David W. Moore, Jr., and Frank G. Willey,
Fairchild Camera & Instrument Corp.,
Jamaica, L. I., N. Y.

The Fairchild system of radio telemetering was designed to transmit indication of aircraft instruments from plane to ground over a conventional aircraft radio transmitting and receiving equipment. Ground indication is made by an indicator which closely simulates the standard aircraft instrument in appearance and modification to the aircraft instrument in the plane in flight. Instrument indication is transferred into electrical phase angle which may be transmitted by radio equipment. This phase angle is then compared with a reference signal in the receiving station and converted to a dial indication. Provision may be made for sending a number of instrument indications over a single carrier, enabling transmission of indications of a flight group of instruments from, for example, a radio-controlled plane or missile to a distant operating point, either on the ground or in another plane.

THREE-BEAM OSCILLOGRAPH

Gordon M. Lee,
Central Research Laboratories,
Red Wing, Minn.

Transit time distortion is a fundamental limiting factor in the application of high speed cathode ray oscillographs to the recording of high frequency voltages of fast transients. A 3-beam, high speed, micro-oscillograph was described in which the transit time reduction in deflection sensitivity is calculated to be but 4% at 3,000 mc and 40% at 10,000 mc. Single-sweep oscillograms of 3,000 and 10,000 mc oscillations and 10^9 second transients were shown.

RECORDING POTENTIOMETER

V. L. Parsegian, Portable Products Corp.,
C. J. Tagliabue Division,
Brooklyn, N. Y.

A new high-speed recording potentiometer was described, having a carriage travel of 10 in. in 1 sec. and balancing to within an accuracy of 0.1% of full range. The instrument is of the photoelectric type, using a new sturdy, short period, low inertia error galvanometer, a photocell, and a phase reversing amplifier which drives a split-phase carriage motor when the photocell illumination exceeds, or is less than, an intermediate balance value. Means for cancelling the galvanometer lag is described, as well as a new thyratron circuit for printing records.

HIGH SPEED RADIOGRAPHY

C. M. Slack and D. C. Dickson,
Westinghouse Electric Corp.,
Bloomfield, N. J.

The making of ultra speed radiographs, using exposure times of the order of one millionth of a second, requires the passage of electron currents of 1,000-2,000 amperes. Such currents can be supplied by an electron source utilizing field emission from a cold cathode electrode which degenerates into a metallic arc in a high vacuum. The recording of such high speed transients was briefly discussed.

DIRECTIONAL COUPLERS

W. W. Mumford,
Bell Telephone Laboratories, Inc.,
New York, N. Y.

The directional coupler is a device which samples separately the direct and reflected waves in a transmission line. A simple theory of its operation was given and several applications were discussed.

POWER LEVEL RECORDER

A. J. Williams, Jr., and W. R. Clark,
Leeds & Northrup Co.,
Philadelphia, Pa.

The new Speedomax power level recorder is an instrument that faithfully records rapid or slow variations in power level with time, and is independent of variations in frequency within its frequency range (25 to 150,000 cycles). The recorder scale is linear in db. A 20 db change in power input can be recorded in about 1 sec. The new circuits used in this new recorder were described in detail, and its performance characteristics given.

TUBE GLASS PROBLEMS

Dr. Henry J. Miller
RCA Victor Division, Harrison, N. J.

The use of miniature tubes in military equipment made it necessary to develop stem making and stem-to-bulb sealing technics. Tubes which would withstand severe mechanical, thermal loading, shock, and vibration tests were necessary. Three factors which govern the mechanical stability of the tube stem are buffer gas, depth of insertion, and strain. Methods to control these factors were described. The stem-to-bulb sealing technic required to obtain a seal of maximum mechanical rigidity was outlined. It was shown that the resulting procedures for the mass production of tubes were successful. They withstood the severe mechanical stress of wartime use without any epidemic glass failure in the field. A life test was outlined in which the base pins were bent out 5°, the tubes were then placed in boiling water. The shock accelerated any capillary action of cracks in the tube base.

STAGGER TUNED AMPLIFIERS

Dr. H. Wallman
Radiation Laboratory, M.I.T.

In radar and television receivers, the simplicity of single tuning commends itself for wide band, band pass amplifier design. Unfortunately, present tubes preclude the possibility of building a high gain amplifier wider than 4 mc. Bandwidth decreases rapidly when single tuned stages are cascaded. Stagger tuning of individual stages makes 10 and 15 mc wide amplifier design feasible. Graphs were presented which condensed the basic design of wide band amplifiers into a simple procedure.

VELOCITY MODULATION

James F. Gordon
Bendix Radio Division, Baltimore, Md.

An FM system was described in which a crystal-controlled pulse triggered a multivibrator. This was accomplished by a crystal oscillator, blocking oscillator, clipper combination. Negative pulses triggering the MVB establish a reference time for the system. Clipping the reference pulse and differentiating the intelligence pulse, which is generated at the crossover point of the MVB cycle, produces a source of time-modulated intelligence. These pulses are used to control the phase of a continuous wave carrier.

ELECTRONIC NAVAL WARFARE

Captain R. Bennett
Bureau of Ships, Navy Dept.,
Washington, D. C.

A general survey of the use of electronic equipment in Naval warfare was given with special emphasis on the progress made during the war. It was pointed out that electronic equipment can no longer be added as an afterthought to Naval vessels. The author stated that as many as 49 different channels were operating at one time on a single vessel. The difficulties of interference between these channels were discussed. An attempt was made to show the inter-relation of military uses of equipment with commercial uses. The effect of standardization and lack of it were indicated as they applied to the military and commercial fields. In this connection some of the circuit developments made during the war were discussed briefly.

AVIATION NAVIGATION AND SAFETY SYSTEMS

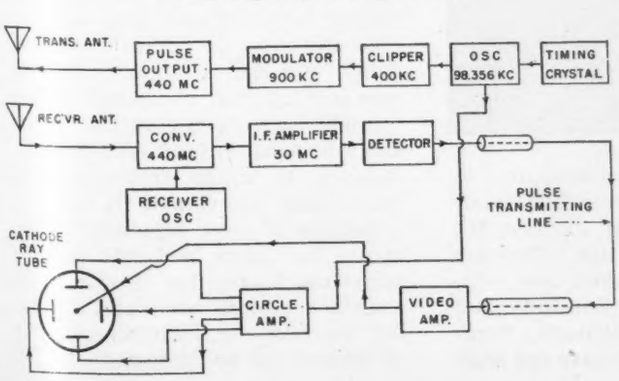
VISUAL DIRECTION FINDER

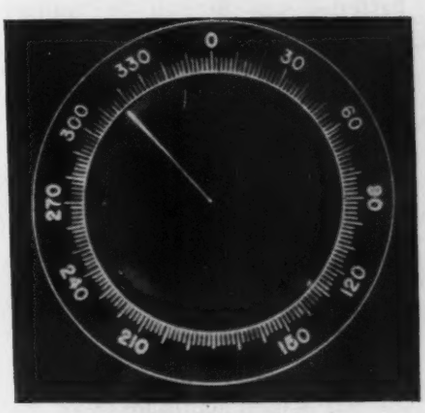
Aldo Scandurra and Samuel Stiber,
Evans Signal Laboratory,
Belmar, N. J.

Radio set AN/TRD-2 is a Signal Corps development designed to provide a portable and mobile direction finder giving instantaneous indications and automatic sense. This direction finder is unique in that the instantaneous indication on the oscilloscope is a single line generated from the center of the screen with a length proportional to the signal strength and the angular position of which indicates the direction of arrival of the signal without sense ambiguity. An additional feature is that noise and modulation are almost eliminated from the visual indication.

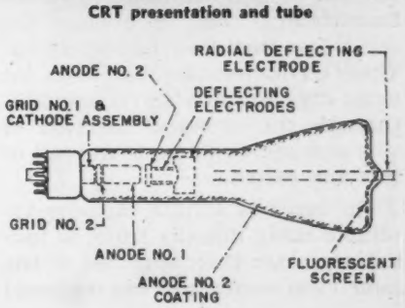
Equipments of this type were useful during the rapid advance of the Allied armies in Europe. It was impossible for the field stations to supply maps at the pace maintained by mechanized infantry. This device provided a means for accurate land navigation.

Block diagram of direction finder





CRT presentation and tube

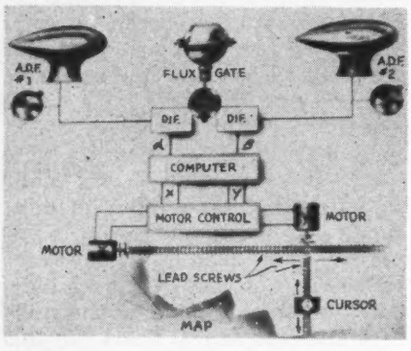


AIRCRAFT PLOTTER

A. C. Omberg and W. L. Webb,
Bendix Radio Division,
Baltimore, Md.

The authors described the development of a device for conveying information from two automatic direction finders and a magnetic heading device into a computer which changes polar coordination into rectangular coordinates. The rectangular coordinates give the position of an aircraft with respect to two ground transmitters, automatically controlling a pen which continuously plots the position of the aircraft on a chart.

Functional diagram of plotter



NAVIGATION SYSTEM

P. R. Adams, Federal Telecommunication Laboratories, Inc.,
New York, N. Y.

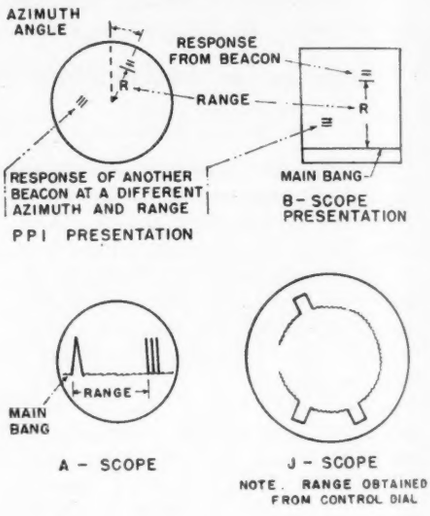
P. R. Adams gave the results of investigation over a period of several years of what kind of system would give 100% reliable communication over the entire surface of the earth. This involved distances up to about 1500 miles. Due to the tremendous variations in signal strength observable in any one frequency band during the course of a year it was finally concluded that only a system utilizing a number of frequencies which could be chosen depending upon conditions would be capable of producing the required reliability. In addition a very narrow channel should be used to reduce noise interference.

RADAR BEACONS

Capt. R. D. Hultgren and L. B. Hallman, Jr.,
Watson Laboratories,
Red Bank, N. J.

The general theory underlying the operation of radar beacons was described. These are devices which receive an interrogation signal from a distant station and automatically send out a coded signal repliyng to the interrogation. The various components such as receiver, discriminator, modulator, coder and transmitter were discussed. Other factors of importance such as operating frequencies, required receiver sensitivity and transmitter power, choice of pulse duration, cause and effect of delay in the beacon were discussed. In addition, the authors surveyed the possibilities for use of this device in aircraft homing, landing, rendezvous, identification and airport surveillance.

Types of data presentation

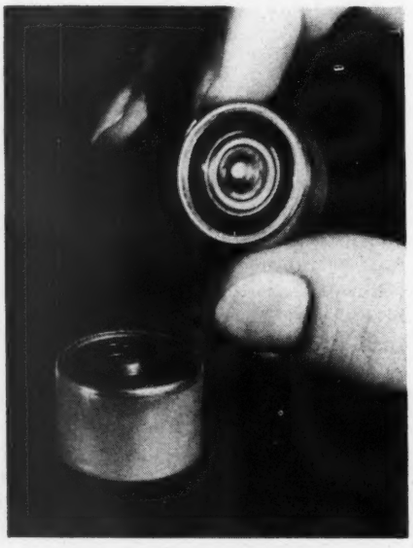


CHARACTERISTICS OF MERCURY TYPE BATTERIES

One of the few important changes in the basic construction of primary batteries was devised by Samuel Ruben, a consultant for the P. F. Mallory Co., Indianapolis, and resulted in a cell that has an ampere-hour capacity four to six times greater than that of the conventional dry cell and an output that is nearly constant throughout its service life. This characteristic is particularly valuable to portable radio and hearing aid users.

Its characteristics include several other features, among which is that it does not need rest periods, its capacity remaining the same whether the cell is used continuously or intermittently. This is because the cell is free from polarization effects. These characteristics vary from the usual dry cell since the cell operates through the chemical reaction of zinc and mercuric oxide instead of zinc and carbon.

The cell has a high capacity-to-volume ratio, initially three to four times greater than batteries of the same cubic content as conventional



dry cells at room temperature. At higher temperatures this ratio greatly increases. In addition the cells have long shelf life. They are hermetically sealed and are relatively unaffected by humidity, hot dry climates or high altitude. Temperatures up to 130°F have but little effect on the substantially flat discharge characteristic. Regulation is excellent. No-load voltage is slightly greater than 1.3 volts. Range of variation is less than .01 volt for new cells.

The battery has a sharper life cutoff and an ampere-hour capacity independent of drain. Within rated limits each cell will exhaust itself and deliver essentially the same number of ampere-hours in continuous or intermittent service.

Each cell is enclosed in a steel case which, taking no part in electrolytic action of cell, does not corrode and mess up adjacent components. For special applications the very low internal resistance makes possible high flash currents. This low and substantially constant resistance at audio frequencies is maintained throughout its life.

Because of more expensive ingredients the price per cell will be somewhat higher for Mallory cells than for typical zinc-carbon cells, but the cost per milliampere hour of service will be competitive.

CBS SHOWS ITS COLOR

High frequency transmission with sound on same carrier demonstrates their solution of color reception problems

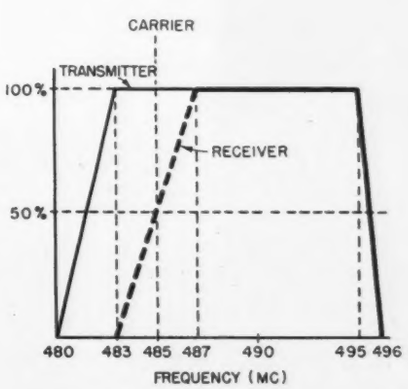
• In 1944 when CBS publicized, so boldly, its belief that higher quality color television was not only possible but immediately practicable, there was loud dissension among many groups who were at the moment concerned with the big problems still to be hurdled using "regular" frequencies. Whether or not CBS was betting on a sure thing, based on their then current investigations is not known, but they showed courage by backing their convictions, going ahead and ordering one transmitter and starting to build another in their own laboratories, together with receivers of various types, cameras and the other necessary parts of a complete system. A brief description of this transmitter is given elsewhere in these pages.

Series of demonstrations

As a result a series of rather spectacular demonstrations showing their progress has recently been conducted from which it is evident that, at least technically speaking, they have reduced the frequently-mentioned "five years at least" by a couple of years or more. Here remember the restriction "technically speaking," because with regard to quality of results and expansion of facilities, much work must still be done before UHF color television can be commercially possible. These will be mentioned later.

In these demonstrations, it was proved that a moderately powerful transmitter with completely satisfactory characteristics can be designed. It was also evident that antenna structures, resonant to these frequencies, became so small physically that multiple arrays or other gain-improving expedients could be utilized to advantage in confining the radiated signal to a horizontal blanket and thus preventing the loss of energy into the sky (where there are no receivers anyway).

In the case at hand, a horizontal slot type transmitting antenna was used which was stated to concentrate the energy from the 1 kw (peak) transmitter into such a blanket, with an improvement of 20-fold at the horizon. Here attention may be called to the characteristics of radio signals. There is no inherent magic in any frequency range of signals over any other range within line of sight distances once they have left the transmitting antenna. The well known differences found in practical experience depend on conditions at the terminal stations. It might be stated that the higher the frequency the less the signal strength picked up (an inverse relation), if a dipole resonant to the frequency in each case is utilized at the receiving position. Or in another way of thinking, all frequencies are received equally, assuming antennas or antenna arrays are used in each case having equivalent effective areas or volumes in space. Or again, with equal sincerity it is true that the higher the frequency the greater the signal, if the more complicated array mentioned in the second case (necessary to build up the antenna to the same size) is designed to increase the pickup from a single direction only.



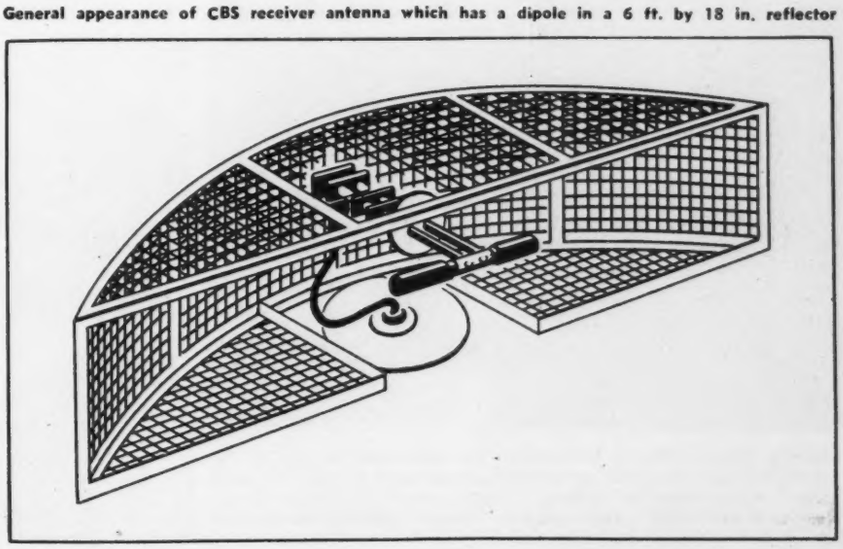
Transmitter and receiver band pass curves

It was in this last mentioned manner that the advantages inherent with the smaller sized halfwave dipoles were utilized with CBS tests to make the higher frequencies even more effective than the lower frequencies heretofore used in the television service. A special reflector was utilized in these tests having an opening 6 ft. across and 18 in. high, providing a reception beam width of 18 deg. (on the half signal strength basis).

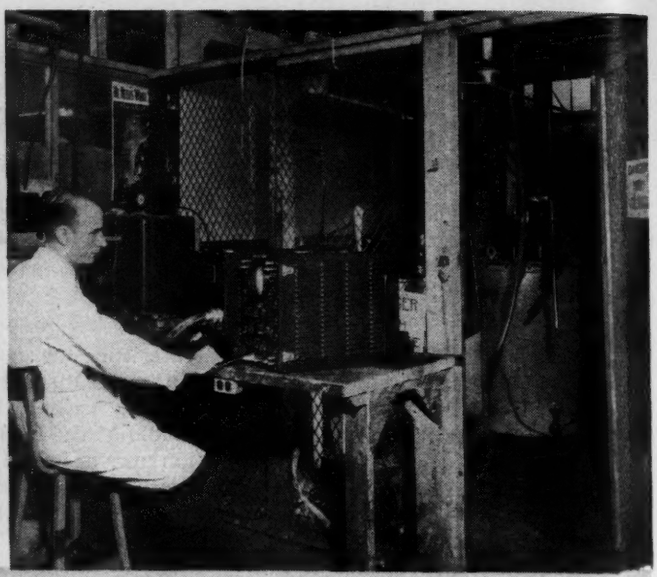
A wide band dipole (obtained by conical shaped members making up the dipole) placed at the center of this reflector, afforded a demonstration of directivity obtainable with a physically realizable structure. The experiments also proved that ghost-free pictures could be obtained by collecting signals that bounded off any one of several tall buildings in the area. This was

(Continued on page 118)

General appearance of CBS receiver antenna which has a dipole in a 6 ft. by 18 in. reflector



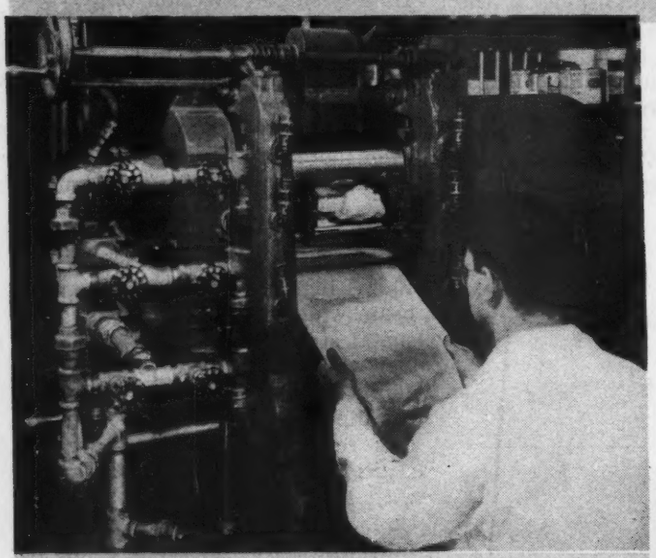
Corner of chemical laboratory carrying on fundamental and applied materials research. Several new plasticizers and synthetic insulating materials have been developed here. These and other laboratory views on this page are of Intelin labs, Federal Tel. and Radio Corp.



Latest piece of test apparatus developed in labs is designed to test surge strength of dielectrics. A standard impulse in kilovolt range is generated and fed across the sample; oscilloscope detects breakdown. New apparatus gives quantitative results and speedy operation

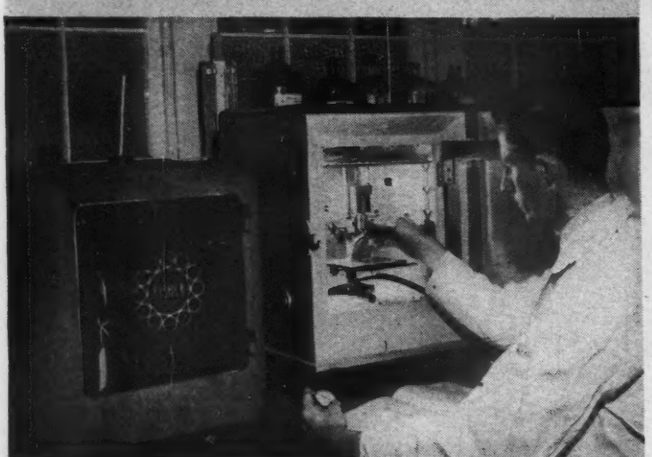
INSULATION

Fundamental and applied re-
in the development and test-

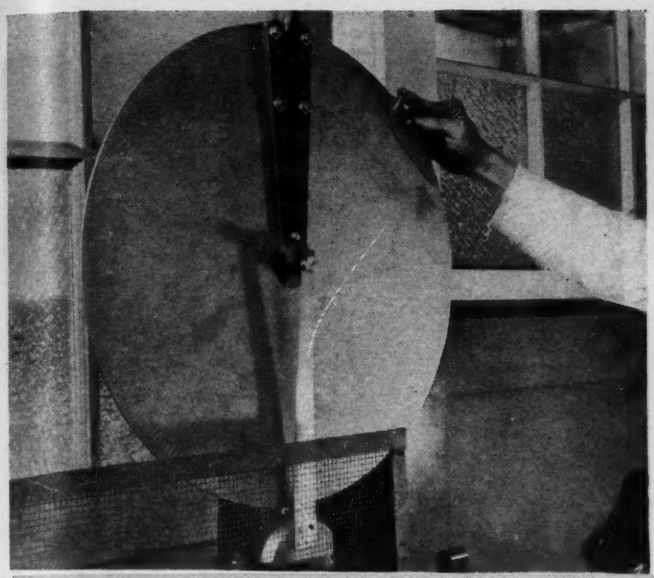


Compounds produced by the Plastics and Chemical groups are sheeted in this calender to yield a smooth, uniform sheet within small dimensional tolerances. Physical and electrical properties of prepared materials are then determined as shown in illustrations on other page

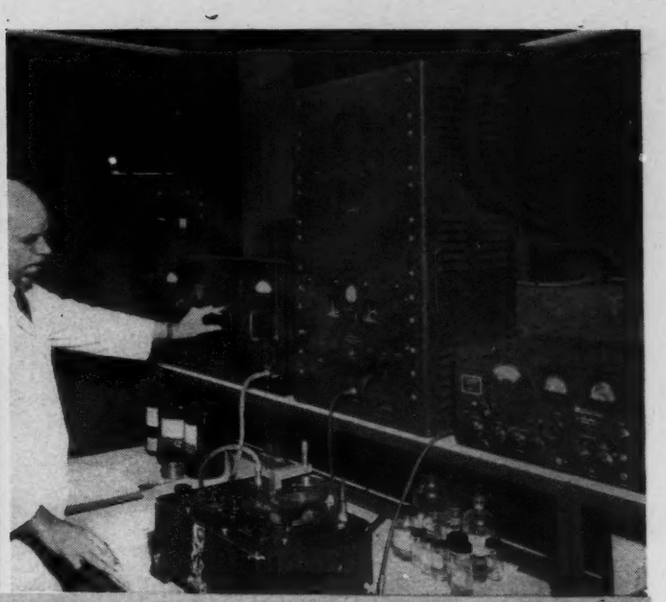
Resistivity of samples of jacketing materials is measured on megohm bridge. Oven at left and water bath at right enable dry and liquid immersion tests to be taken at desired temperatures. Temperature conditioning is frequently used in tests to establish standard condition



Hardness or resistance to indentation and penetration is one of important physical properties of plastic material used in high frequency cable. Measurement of hardness is being made with Shore Durometer, used for elastic thermo-plastics. Sample previously conditioned



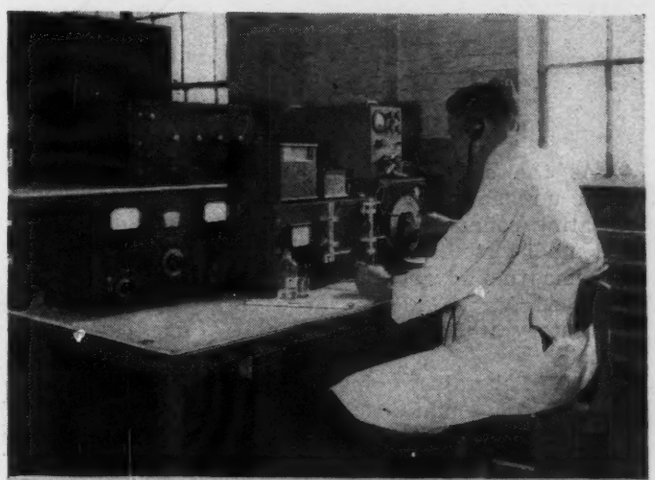
Impact resistance is measured for plastic materials to be used in telephones and as electrical insulation posts. This characteristic indicates the amount of energy required to break a given sample, and is recorded in foot-pounds on the Charpy tester shown in picture above



Dielectric characteristics of materials are important. Power factor and dielectric constant are measured accurately between frequencies of 500 kc and 30 mc with apparatus shown above. Set up to take liquid dielectric measurements, equipment also measures solid constants

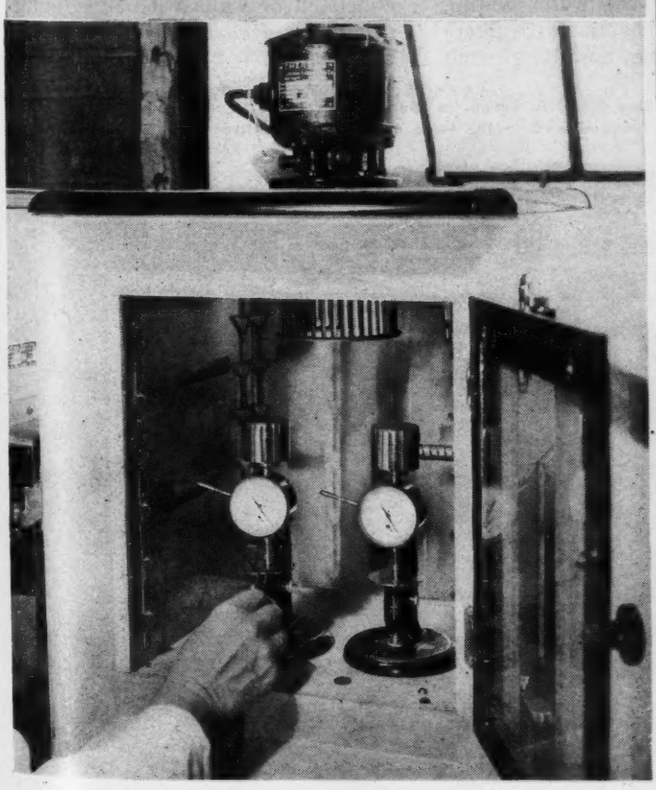
LABORATORY

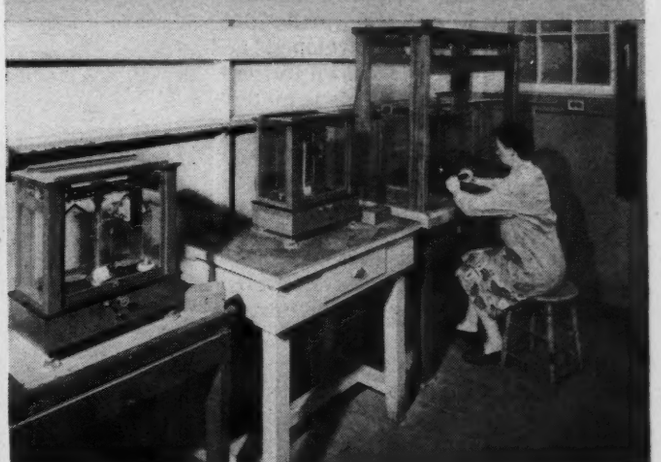
search facilities required
ing of high frequency cables



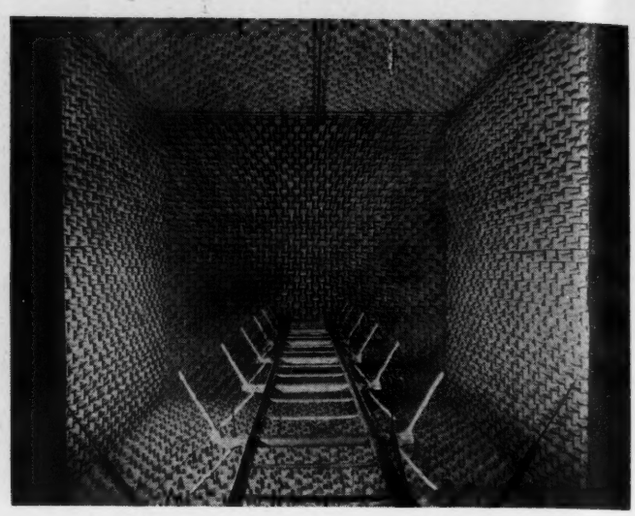
New method of measuring dielectric characteristics at UHF is shown. Using frequency determination to calculate the dielectric constant, this apparatus, which operates at 300 and 900 mc, is capable of higher degree of accuracy than heretofore possible. Technic is rapid

Heat deformation test must be undergone by thermoplastic compounds, particularly if they are to be used as jacketing materials. Here the thickness of the sample is measured in mils before and after it is subjected to a heat treatment; ratio of values determines deformation





Highly sensitive analytical and semi-micro balances, some accurate to 0.00001 gram, are used in connection with analysis of compounds synthesized in laboratory, as well as in determination of their physical and chemical constants. This is picture of Intelin balance room



Left, the audio spectrometer, which splits sounds into 13 bands, in operation. Right, general view of the anechoic chamber showing manner in which surfaces have been treated. Equipment under test is mounted on a car and rolled in on tracks

ACOUSTIC LABORATORY

Harvard scientists and engineers design and build "Anechoic Chamber" in which 99.9% of sound wave energy is absorbed in walls

• As the electronic engineer is often up against the problem of radiating sounds in a satisfactory and undistorted manner, he will welcome the advance in this art produced at the Electro Acoustic Laboratory at Harvard during the war.

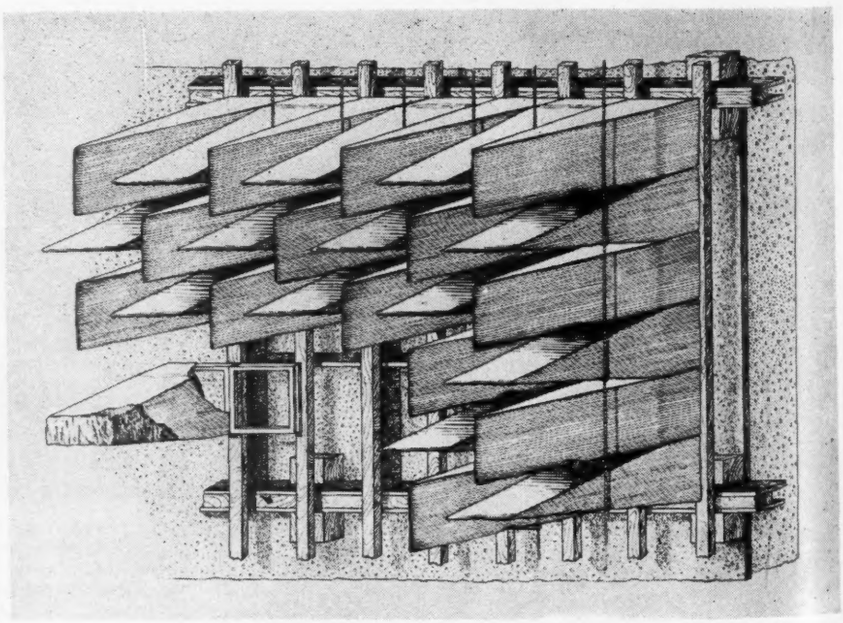
This Laboratory investigated problems of sound insulation for airplanes and other locations near high intensity sound fields and achieved some interesting results.

Under the leadership of Dr. Leo R. Beranek, the Laboratory found that the efficiency of sound insulators depended on the ratio of area to weight and developed a new material which is known in the trade as Fiberglas AA. This is made in the form of ½ in. blankets in which the glass fibers are bound by a plastic and weighs about 1/20th lb. per square foot. Two such blankets sewed to opposite sides of an asbestos paper sheet proved most effective for reducing noise on such planes as the Boeing Super Fortress.

Studies also were carried out to determine the effect of altitude and pressure variations on the intelligibility of speech. To analyze this problem an audio spectrometer was built which separates the sounds of speech into 13 different bands from low to high. Results indicated voice intensity decreased 9/10 at 35,000 ft. and the higher notes tended to be lost. Therefore, amplifiers used under such condition had to compensate for this.

In connection with these studies, the Laboratory built a remarkable room called an "Anechoic Chamber" (meaning "without echo"). In this chamber the walls, ceiling and floor all are covered with fiberglas wedges, base mounted, each alternate wedge being at right angles to its neighbor. Many loud speakers, sirens, microphones, etc., were tested in this chamber and it was found that 99.9% of the sound wave energy was absorbed in the walls at the first reflection. Another unusual room which was built consisted of walls with semi-cylindrical surfaces designed to diffuse noise perfectly.

Method used in installing Fiberglas wedges in the anechoic (echo-free) chamber, all walls and the ceiling and floor being treated in the same manner for effective sound energy absorption



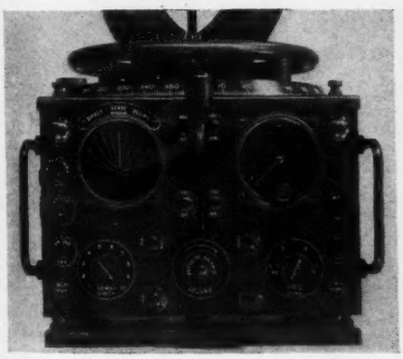
TWIN BEARING DF UNIT

Direction finding carried on simultaneously with message interception from enemy aircraft, patrol boats and tanks

• The Simon Radioguide, a variant of SCR-503-A, is a crossed-loop, twin-channel direction finder using off-null loop position to provide aural reception and visual directional indication simultaneously.

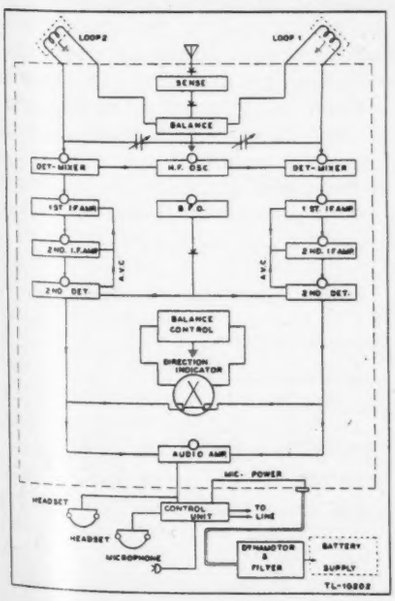
Two eight-inch right-angle loops, encased in a common electro-statically shielded frame, are used. Since the directional pattern of a vertical loop is a cosine function, the two loops respond equally when the arriving signal is in the bisecting plane at 45° to either loop.

A twin-channel superheterodyne receiver is energized by the loops, the outputs deflect two crossed pointers of the bearing indicating instrument. When the loop is oriented with its bisecting plane in the direction of the incoming signal, the deflection of the crossed pointers is "equal".



View of the front of the Radioguide control

Schematic of arrangement of twin channels



General view of the Simon Radioguide as set up for operation in the field. Sense antenna projects through the axis of the shielded crossed loops. Power supply is 12-v storage battery and dynamotor

The frequency range of the equipment is from 0.1 to 1.0 mc, and from 1.0 to 3.0 mc. The two ranges are covered by individual units.

Since the instrument possesses an inherent quadrantal ambiguity, a specified procedure is used in its resolution. By pressing a balance control button, the operator determines whether the transmiting station lies ahead or behind or in a beam quadrant. This operation ungrounds the two loop return leads and connects the loops in series. The resultant signal voltage is applied to the control grids of the first tubes in each channel.

If the signal arrives from a beam quadrant, the two loop voltages will cancel, causing both pointers to fall to zero. If the signal arrives from fore or aft quadrants, the two loop voltages combine in phase, and the pointers stay at the same level.

The second step is resolution of

(*Continued on page 124*)

TUNABLE MICROWAVE

By J. J. GUARRERA
Engineering Department
Bernard Rice's Sons, Inc., New York

Design of line-tuned circuits for use with lighthouse tubes as local oscillators, transmitters or signal generators

• In the construction of oscillators for uhf and microwaves, it has been customary to utilize line-tuned circuits when frequencies became such that conventional circuit elements could not be used. However, the available tubes up to this time created quite a problem in adapting line-tuned circuits for use as oscillators since lead inductance and stray capacitance would frequently make the circuits impractical. The cavity resonators, that will be discussed in the following text, use the new lighthouse[1] tube, which eliminates most of the difficulties encountered when using coaxial lines as resonant circuits. This tube has been specially designed for use in the microwave and uhf region. Its physical construction is such that lead inductance is kept at a minimum and coaxial lines can be adapted quite readily as circuit elements. This can be seen in Figs. 1 and 2, which show schematic views of two different types of oscillators using this tube.

These cavities can be used as local oscillators, transmitters or signal generator oscillators in the micro-wave region.

The double coax lighthouse tube cavity resonator shown in Fig 1 uses a tuned coaxial line in both the cathode-grid and grid-plate circuits. As is indicated in the drawing, the grid line is common to both circuits as the inner conductor of the cathode-grid circuit and the outer conductor of the grid-plate circuit.

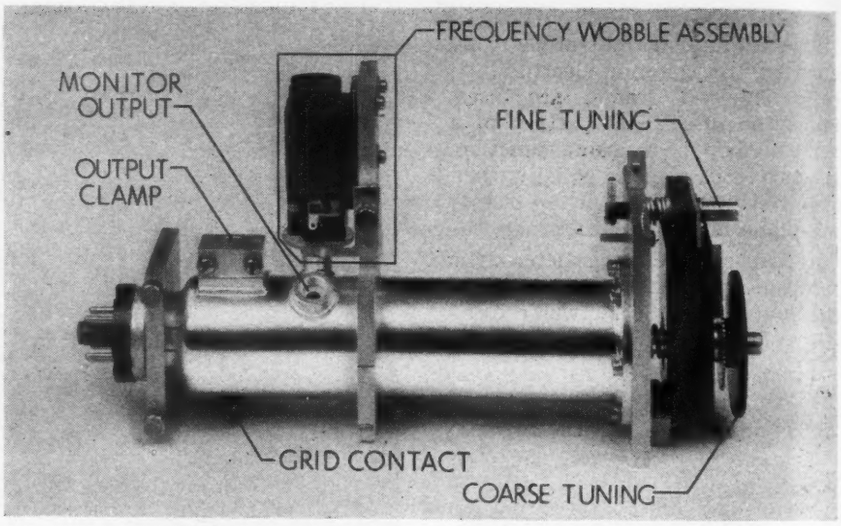
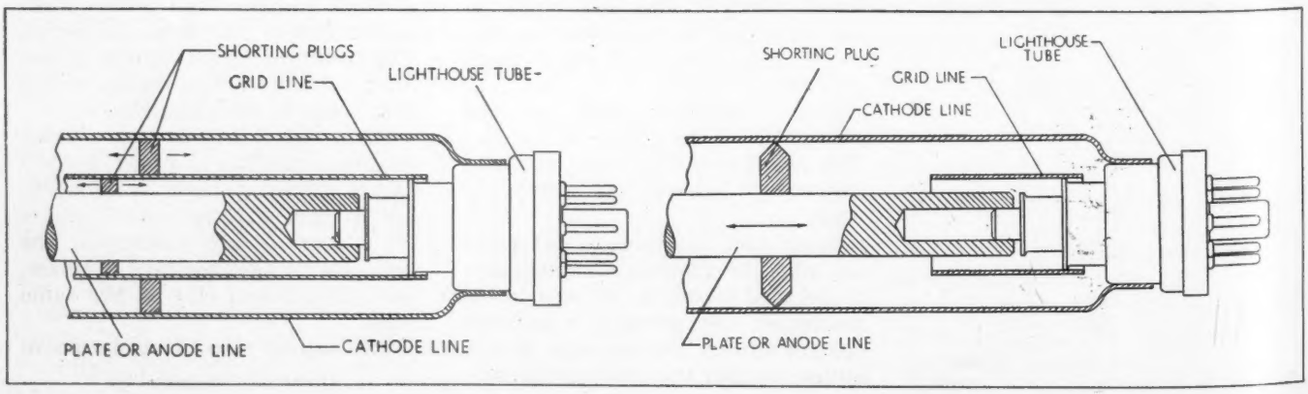


Fig. 4—Design incorporating a monitor output and "wobbler" to vary frequency slightly

The mechanical layout is such that the construction of an oscillator of this type is quite straightforward. The cathode line can be of brass tubing approximately 1½ in. in diameter with one end spun or drawn to the dimensions of the tube. This "neck" should then be slotted so the tube can slide in and out easily. Then a clamp should be used to hold it firmly in place when in operation.

For the grid line, brass tubing, having the same inside diameter as the outside of the flange of the tube, can be used and should be slotted to permit a spring contact. If more clearance is desired in the plate-grid circuit, slightly larger diameter tubing can be used with a short neck spun or drawn as in the cathode-line. Similarly, for the plate line, rod or tubing can be used and should be machined and slotted so that it grips the plate cap of

Figs. 1 and 2—Schematic drawings of two types of oscillators designed for lighthouse tubes



CAVITY RESONATORS

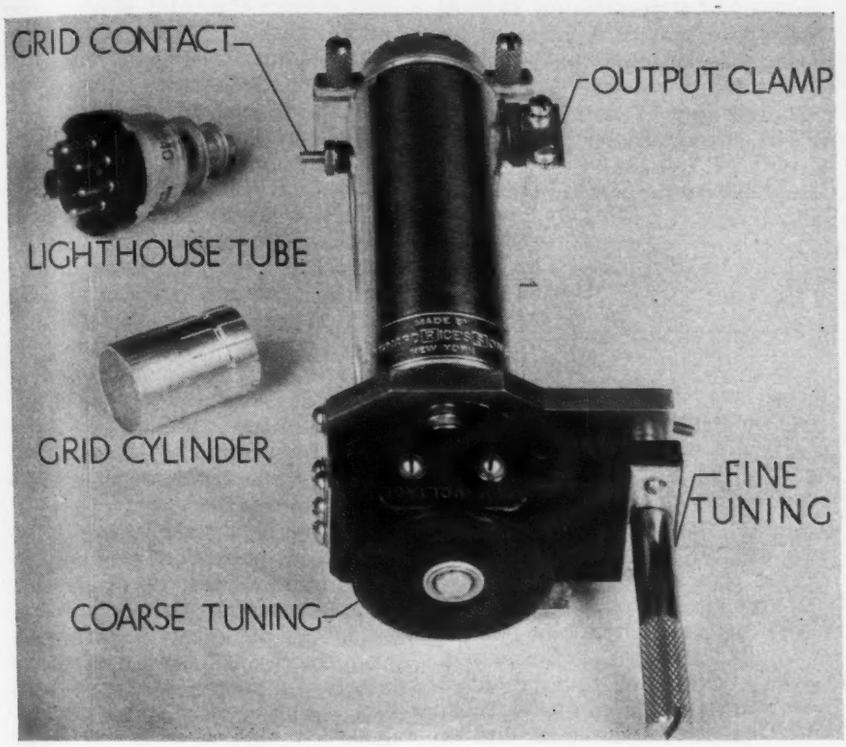


Fig. 3—Showing the Lighthouse tube and grid cylinder removed from the cavity

the lighthouse tube firmly.

The coaxial lines are tuned by means of adjustable "shorting plugs" which are fabricated so that they act as an effective short for the microwave energies without interfering with the dc circuit. Bakelite rings can be used between the lines as spacers to locate them correctly and keep them in place. The spacers should, of course, be assembled behind the "shorting plugs" so as not to interfere with the rf circuit.

The mode of oscillation of this double coax resonator is determined by the "shorting plug" position and the feedback arrangement. For example, if the feedback is such that it will maintain oscillations in the region of 10 cms, then the cavity will oscillate when the "shorting plugs" are located the proper number of quarter wavelengths back from the tube so they, too, will support the 10 cm oscillations.

For a cavity that is required to oscillate over only a limited range, a quarter-wave choke can be used as a shorting plug. (Fig. 6) It is quite evident that this is rather simple to fabricate. The spacing between the choke and the wall of the tube is determined by the amount of dc voltage applied to the plate of the tube. The smaller the spacing the more effective the "choking" or "shorting" action will be.

For a cavity that is required to oscillate over a broad band this choke type short would be impractical since the quarter-wave "choking" effect would take place only over a very limited range. To meet this requirement, a capacitance type "shorting plug" was designed as shown in Fig. 7. This "shorting plug" is quite effective and satisfactory in the microwave region. The design shown in Fig. 7 is only one of the many ways of accomplishing this capacitance type "shorting" action.

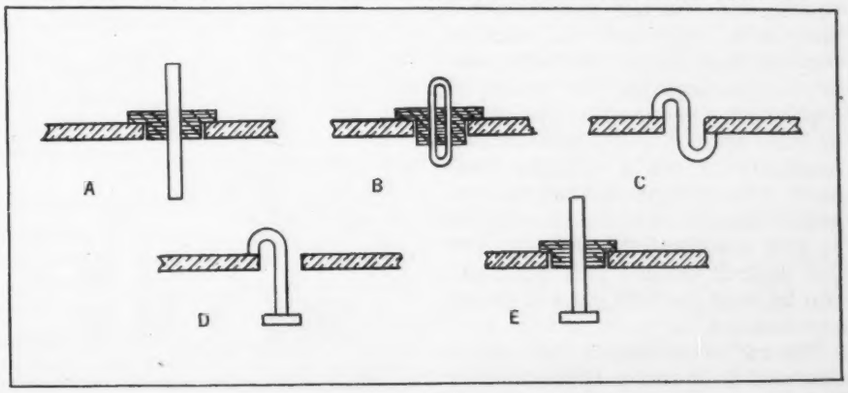
This type of resonator can be made to cover an extremely wide range of frequencies. The shortest wavelength obtainable is limited by the electrical characteristics of the tube itself and for the lighthouse tube this lower limit is in the region of 8 cms. The only limit to the longest wavelength obtainable is the physical size of the resonator. For this circuit to operate over the entire range, it is necessary to introduce proper feedback between the plate-grid and grid-cathode circuits. This can be accomplished by a number of methods. Some of the more common and simpler ones are:

(1) Introducing a loop between the cathode-grid and grid-plate circuits. This is usually satisfactory for short wavelength oscillations in the order of 10 or 12 cms when the lines are resonating in the three-quarter wave mode so that the loop can be introduced at a point of voltage minimum without interfering with the motions of the "shorting plug."

(2) Introducing a capacitance probe between the cathode-grid and grid-plate circuits. This type of feedback generally is used for the longer wave-length oscillations when the line is operating in the one-quarter wave mode, and the tube end of the cavity can be considered a point of voltage maximum.

(3) Introducing a combination of capacitance probes and loops through the wall of the grid line. This arrangement generally is used when a band of oscillations must be covered which does not fall clearly in either of the above two cases. For example, if an oscillator were desired to cover the range from 10 to 20 cms, a feedback system would

Fig. 5—Cross sectional views of various loops and probes used for feedback purposes



nave to be devised to maintain proper oscillating conditions througout this range. On the other hand if an oscillator were desired from 8 to 12 or 15, cms, it is very likely that a loop alone would suffice.

In Fig. 5 are illustrated a series of cross-section views of various loops and probes used for feedback purposes. The operating range of any given setup is limited by the feedback system, which usually is quite frequency sensitive unless elaborate and complicated mechanical arrangements are made for broad band operation. Frequently the band of operation in an oscillator can be made quite broad by the use of a combination of the loops and probes.

Since the lines in this double coax resonator are terminated with "shorting plugs," the oscillations are of an odd quarter-wave nature. For oscillations on the order of 25 cms and greater, the fundamental quarter-wave mode invariably is used in order that the physical dimensions of the cavity may be kept as small as possible. However, when oscillations in the region of 10 and 15 cms are desired, it becomes necessary to operate the cavity in the three-quarter wave mode and sometimes five quarters

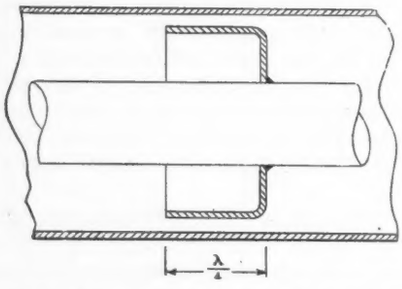


Fig. 6—Quarter wave choke used in cavity as a shorting plug

since the loading action of the tube places the first voltage minimum almost within the glass envelope.

This type of cavity is slightly awkward in use since it requires tuning the cathode-grid line, the plate-grid line and in addition maintaining proper feedback conditions throughout the range of oscillation. These adjustments can be quite critical, and it sometimes is necessary to use a variable feedback arrangement so that the resonator can be tuned and adjusted to give satisfactory operation over the desired band. This resonator can be used for both cw and pulsed applications.

The cw power output that can be obtained at 10 cms is approximately .1 to .5 w with 5 w of dc power supplied to the circuit. In pulsed applications where the peak of the pulse supplied to the anode is 800 v or greater, the oscillator has an efficiency of approximately 10%. As this type of cavity is adjusted for longer wavelengths, the efficiency of operation increases.

Another type of oscillator, known as a re-entrant cavity, is shown in

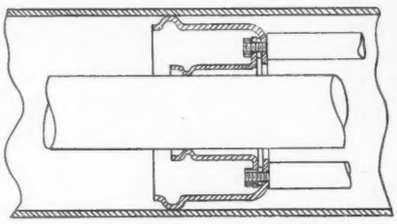


Fig. 7—Capacitance type shorting plug

Fig. 2. This unit also uses coaxial lines in both the cathode-grid and grid-plate circuit. However, these lines are not tuned in the same manner that is used in the double coax resonator. Instead of terminating the tuned circuits in "shorting plugs," the grid line is made one-half wave long and mounted directly on the flange of the tube.

The length of the grid line is fixed for any given setup, and thus becomes the frequency-determining factor in the circuit.

The "shorting plug" in the re-entrant cavity is mounted on the plate line and functions as an rf short between the cathode-plate circuit and is located an odd number of quarter wavelengths back from the end of the grid cylinder. These are the only points at which oscillations will take place.

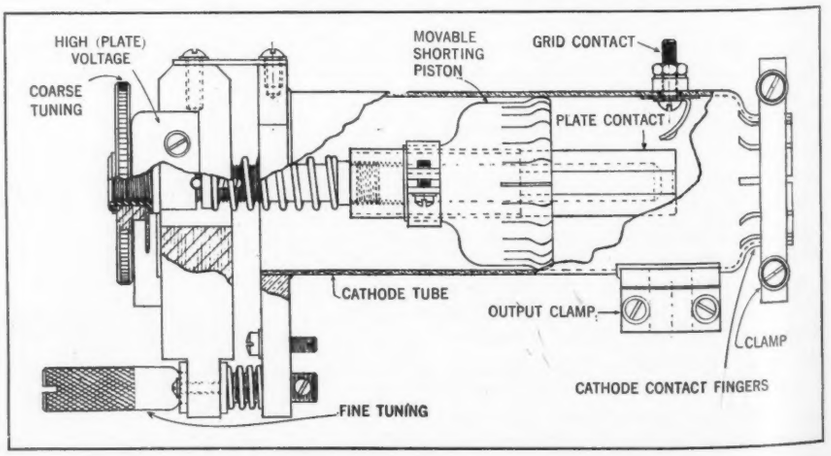
Motion of the "shorting plug" does affect the resonant frequency of the circuit, but its function is primarily to optimize conditions for oscillation with a given grid cylinder rather than to change the frequency. The grid cylinder on the other hand functions as the frequency-determining factor in the circuit, and its length, therefore, is critical. Small variances will change the band of oscillation appreciably.

By comparing Figs. 1 and 2, it can be seen that the construction of this re-entrant cavity is very similar to the construction of the double coax cavity, which was described previously. The fundamental difference between the two units is that the grid line in the re-entrant cavity is mounted directly on the tube and is supported and held in position in this manner. The "shorting plug" in the re-entrant cavity is mounted firmly to the plate line and forms a sliding contact to the cathode line. These two differences make the re-entrant oscillator simpler to construct and easier to operate.

Tuning is accomplished in this circuit by a motion of the plate rod on and off the cap of the tube, as is indicated by the arrow in Fig. 2. Motion of the plate line away from the tube effectively introduces a series inductance in the plate grid circuit, which causes the frequency to decrease or the wavelength to become longer. The amount of tuning that can be obtained by this method is approximately 1 cm in the region of 10 cms. This resonator, therefore, can be tuned over a 10% band with only one control which makes it an extremely practical and simple device for use where tuning is necessary, provided that the required tuning does not exceed the limits over which a given grid cylinder will perform satisfactorily. This unit customarily is used in the region from 8 to 12 cms, since operation at longer wavelengths proves impractical.

(*Continued on page* 120)

Fig. 8—Cross sectional view of Lighthouse tube tunable cavity showing tuning arrangement



LABORATORY KEYHOLE

Current Research that Forecasts Future Electronic Developments

5 KW AT 300 MC—Dissipating more energy per unit area than has heretofore been possible, a parallel-plane water-cooled tube developed by RCA laboratories is capable of developing 5 kw of output power at 300 mc. Principles of electron optics are used in the tube's design. The massive plate is contained within a glass envelope, and communicates to the exterior by means of a tube which encloses two smaller tubes through which water enters and leaves. Seals and stems are completely water-cooled. The tube is a double tetrode with partial internal neutralization.

ELECTRONIC BONDING—A bond is needed between the steel head of a golf club, weighing between 8½ and 10 oz., and the steel shaft. An induction heating method to secure this bond has been worked out in a testing laboratory of the Commonwealth Edison Co., Chicago. The tapered hole in the steel head was coated with polyvinyl acetate, the tapered shaft inserted in the hole, and the unit heated inductively to 350° F. in 1 sec. After cooling, the club was submitted to a very severe torsion test, and the bond pronounced unbreakable. Method has added advantage that no subsequent polishing is needed, as the heating does not in any way discolor the chromium plating.

MEASURING THIN COATINGS by X-ray absorption is reported by L. S. Birks and H. Friedman of the U. S. Naval Research Laboratory. Characteristic X-rays were reflected from the base material and the diffracted intensity measured by a Geiger-counter system. When the base material was covered with a thin coating, the X-rays were reduced in intensity according to the exponential absorption law for the coating material. Metal plating thicknesses were determined in the range from 10^{-5} to 10^{-2} centimeters. The method is generally applicable to coatings of any material or combination of materials whose X-ray absorption coefficients are known.

ELECTRONIC GRADER—C. W. Rupprecht, Long Island industrial engineer, is developing an electronic grader which will sort malleable iron castings according to their machinability and tensile strength. In the initial stage, castings travel through three successive magnetic fields. Accept and reject relays driven by degenerative amplifiers complete the grading operation. The process will be high-speed according to Rupprecht, and will not slow down the foundry production line. He points out that castings which are too hard may damage tools, while those which are too soft may not hold up in use. The electronic device will replace a slow piece-by-piece drop-test now in use.

HIGH COST OF LAB MODELS is illustrated by recent revelation of figures on hand-built color-television sets. For pioneer 10-inch direct-view color televisor cost-sheet totalled $3,150; for 18-by-24-inch color projection model, $5,900. However these costs of course have no bearing on future customer prices for production-line jobs, which will be much lower. (Early models of FM sets from same laboratory cost $2,400 each, though similar sets were later placed on market at little more than prices of ordinary radios.)

NOTE FOR ELECTRONIC GARDENERS—For the past three years, using electronic amplifiers, Dr. H. T. Stetson has been continuously measuring the flow of sap in a tree near his Needham, Mass., laboratory. In 1946, sap had already started to flow early in Januyear. In 1945, the sap started up in February, predecting the early Spring a year ago. But now, in 1946, sap has already started to flow early in January, probably as a result of the early-January warm spell. Nearby maple-sugar farmers also found the maple sap flowing in January. Does this mean another freak growing year in 1946?

RADAR MOON MAPPING—Sir Edward Appleton, in a paper presented before the Physical Society of London, proposes to use radar in measuring heights of lunar mountains, craters and plateaus. By using very short waves, Sir Edward believes that sufficient resolution could be obtained to make altitude measurements never before possible since the moon always presents the same face toward the earth; hence lunar objects are always seen from the same head-on angle.

FLAME PHOTOMETER—A new laboratory instrument has been developed for indicating concentrations of sodium, potassium and calcium in a sample. Using the well known kitchen experiment of throwing salt (sodium chloride) into a gas flame to watch the color change to a brilliant yellow, in this new flame photometer a sample of the substance to be analyzed is dissolved in water and a mist of the solution atomized into a special gas flame. The light, characteristic of the desired element, is gathered from the flame by an optical system and glass filters and then directed on a photoelectric cell. The amount of light reaching the photoelectric tube sets up a proportionate electric current in a meter circuit. The final meter reading is therefore an indication of the concentration of sodium, potassium or calcium in solution in the sample. The sensitivity of the unit is such that 1 part of sodium in 10,000,000 parts of water may be detected.

PREFABRICATING PROPELLERS—According to report, manufacturing processes in the production of large steel propellers for marine use has been facilitated through the use of induction heating. Passing a coil gradually down the blades gives the necessary heat pattern for brazing without destroying the physical properties of the metal.

NOTE: *Please don't ask us for more details about any of the foregoing. We present here all the information we have. As soon as we get more about any of these situations, full details will be printed in Electronic Industries. Our editors run across many interesting tips, leads, and rumors, both well-founded and baseless. We thought you would be interested in hearing about them, even if we can't give all the details or vouch for their authenticity. Editors.*

LORAN INDICATOR

Propagation considerations that determined frequences—an analysis of design and functioning of various circuit elements

By DAVID DAVIDSON
Radiation Laboratory, M.I.T.

• In any discussion on Loran indicator circuit operation it is worthwhile at first to examine the elements of the system and then to define the requirements to be met by the navigator's instrument. Recent articles have appeared,[1,2,3,4] however, which deal with the Loran system and its development in an entirely adequate fashion, so that this paper will review only those concepts which influence Loran indicator design.

In Loran, a navigator measures the time difference of arrival of pulses from two widely-separated transmitting stations with a nominal reading accuracy of about a microsecond. Since the stations are rigidly synchronized, the contours of constant time difference are a family of spherical hyperboles having the station locations as foci.

In order to obtain a fix, a navigator will require at least one other time difference reading from a second pair of stations. As a single station may be common to two pairs, it takes at least three Loran stations to provide fixing coverage. Certain ocean areas are presently covered by chains of as many as eight Loran pairs all operating on the same radio frequency and identified by the different recurrent rate assigned to each pair.

Station synchronization may be pictured with a familiar analogy, shown in Fig. 1, that of water waves. A wave from the master appears first, and at some time after this wave has passed the slave, the latter originates a wave of its own. Consider the relative position of the waves at any instant. Since the velocity of each is equal, they will forever advance outwards with constant separation, the exact amount depending upon the position of the observer.

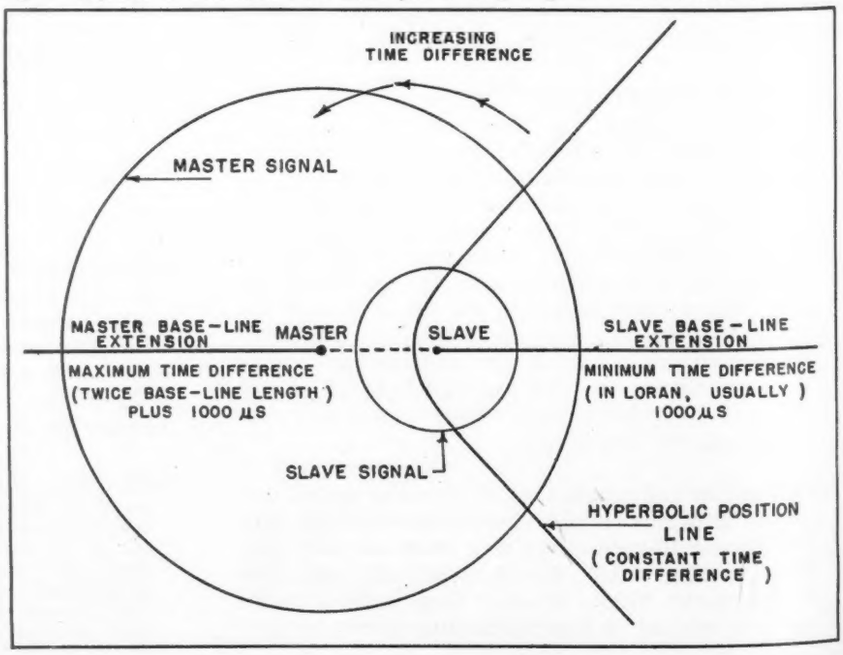
It is evident that the minimum lag of the slave behind the master will occur along a line directly behind the slave and in oposite direction from the master; this is the slave base-line extension. The maximum time difference observable will occur on the master base-line extension, with intermediate values in the area between the extensions. The range of values is clearly dependent only upon the length of the base line.

The choice of Loran frequencies, the 2 mc region, was guided by several propagational considerations, the most striking one being indicated in Fig 2. Obviously, the lower the frequency, the greater the ground wave range. But with the broadcast band being inviolate, pulse technic below this band being increasingly difficult as the frequency is lowered, and the increase in range with lower frequencies being somewhat compromised by the attendant increase in noise level, it seemed best to operate as close to the upper end of the broadcast as possible, in the region of the dip in the noise curve for daytime.

Here, the daytime absorption properties of the E-layer are optimum, resulting in such a reduced noise level that a good ground wave range is available during daylight. With present Loran transmitters, about 70 kw pulse power is radiated on the average, so that a daytime range of 700 miles over sea water is quite common. The nighttime ground wave range is perhaps reduced by 100 miles owing to the increased noise level; this is also evident from Fig. 2.

With the advent of sunset, the E-layer is reduced to a tenuous, thin, reflecting region which refracts incident radio waves of medium frequency with remarkably low loss. At 2 mc, single and multiple reflections occur from the E-layer, and these are followed by

Fig. 1—Sequence of transmission for Loran pair showing range of time difference encountered



1. Pierce, J. A., "An Introduction to Loran", Proc. I.R.E. Paper, in Press.
2. Fink, D. G., "The Loran System. Part I.", Electronics, November, 1945.
3. McKenzie, A. A., "Loran—How It Works", QST, December, 1945.
4. Watson, F. G. & Swope, H. H., "Loran", Sky and Telescope, December, 1945; and "Loran Tables and Charts", Sky and Telescope, January, 1946.

CIRCUIT OPERATION

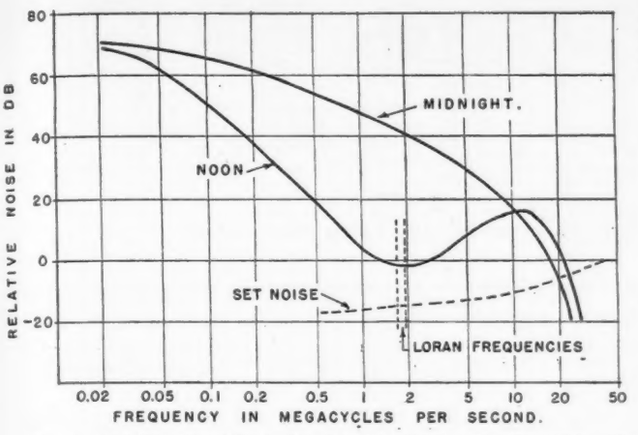


Fig. 2—Variation in noise level with frequency in the temperate zone

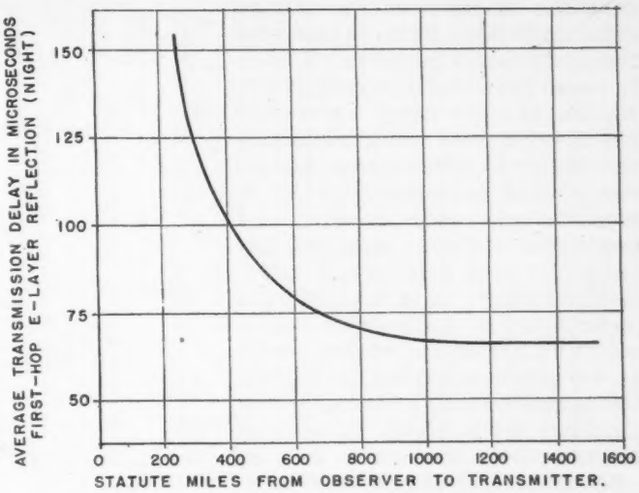
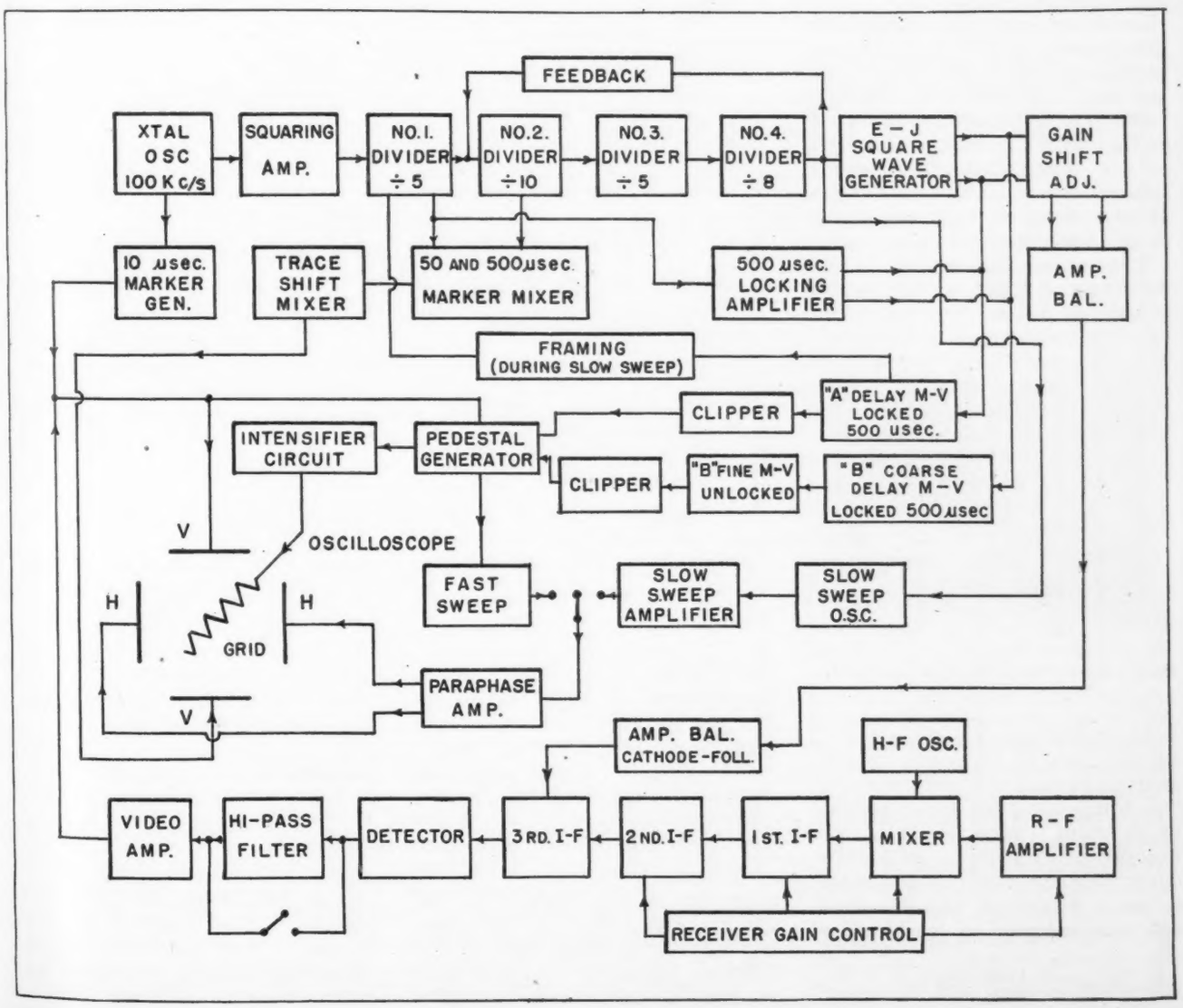


Fig. 3 right—Loran sky-wave delay curve during 1942-43 winter

Fig. 4—Block diagram of Model DAS-1 Loran receiver-indicator



numerous reflections from the night F-layer.

Experimentally, it was determined by numerous Radiation Laboratory field observations,[5] that the stability of the singly-reflected E-layer signal is adequate for navigational purposes. This is formally expressed by stating that the transmission delay for a first-hop, E-layer reflection at night can be related to the distance of observer from a transmitter by a rather simple curve such as the one given in Fig 3. Actually, the curve is a band with greater width at short range, indicating greater probably error of the delay of the sky wave behind the ground wave. At 400 miles, the delay is roughly 100 microseconds, while at great distances it is about 70 microseconds.

Second and multiple hops of both E and F layers are too unstable for use in a navigation system. The service provided by nighttime first-hop E reflections allows the extension of Loran coverage for a pair of stations to more than double the daytime range, and the limit to this nighttime range is determined by the relation between the effective "layer height" and the curvature of the earth. In fact, the absence of first-hop E reflections beyond 1600 miles has been somewhat facetiously termed a proof of the earth's curvature!

Thus we see that ionosphere reflections result in the reception of a train of pulses for each Loran

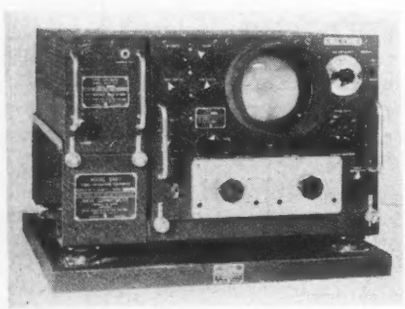


Fig. 5—Model DAS-1 Loran receiver-indicator

signal radiated, and these trains extend several thousand microseconds beyond the ground wave. The intensity of the latter portion of the train is rather weak on the average and so causes little difficulty. At any rate, the navigator is solely concerned with the first 500 microseconds of each pulse train, for in that portion will be found the ground wave, the first-hop E, and the second hop E; satisfactory operation of the system at night is dependent upon the proper identification of these components. The splitting of the sky-waves and their slow fading leaves little doubt as to which is the ground wave.

5. Pierce, J. A., Loran Report No. 16, Radiation Laboratory, M. I. T., January 22, 1942.

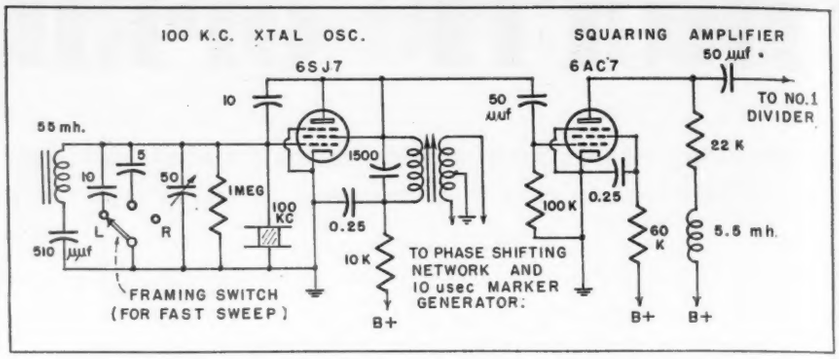


Fig. 6—Crystal oscillator and squaring amplifier circuits

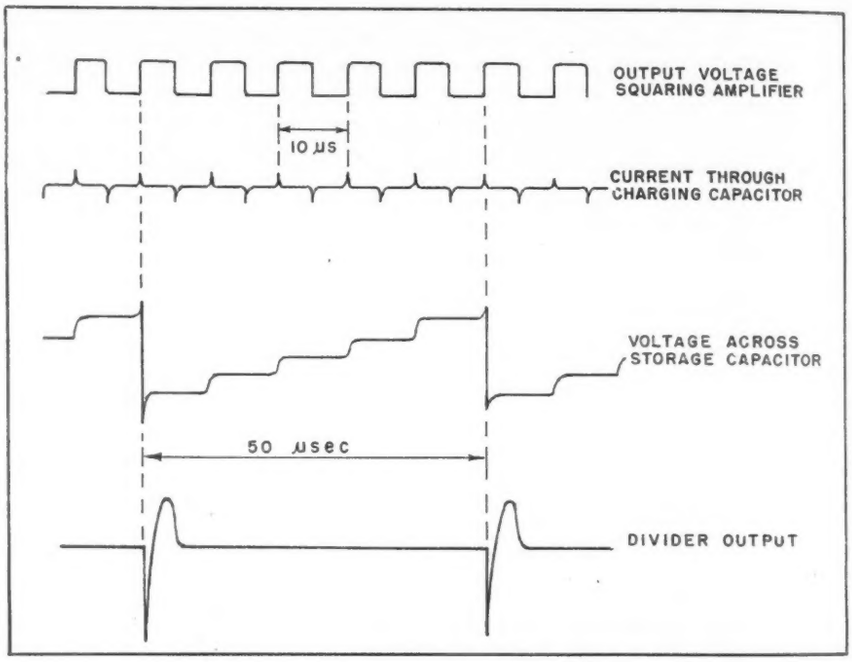


Fig. 7—Waveforms, first divider circuit

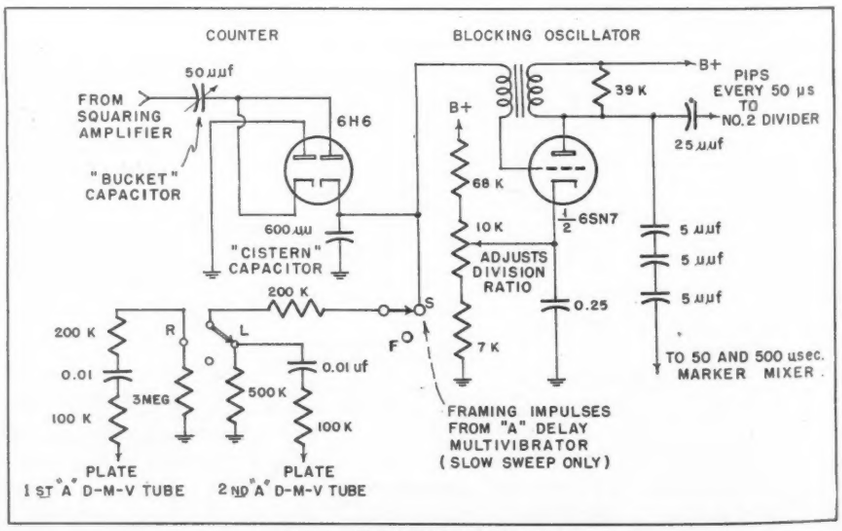


Fig. 8—First divider stage (÷5)

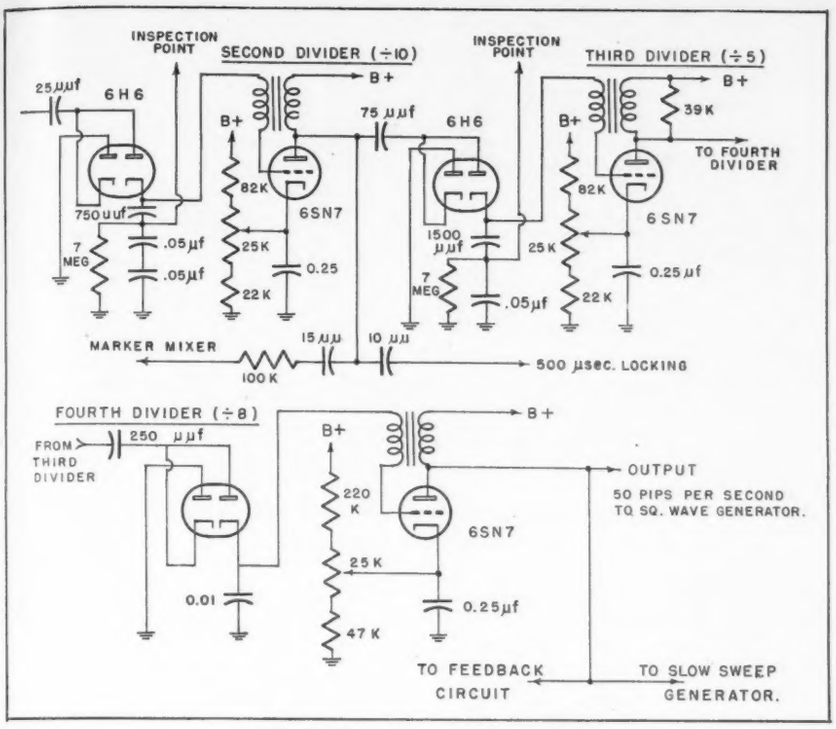


Fig. 9—Remainder of divider chain

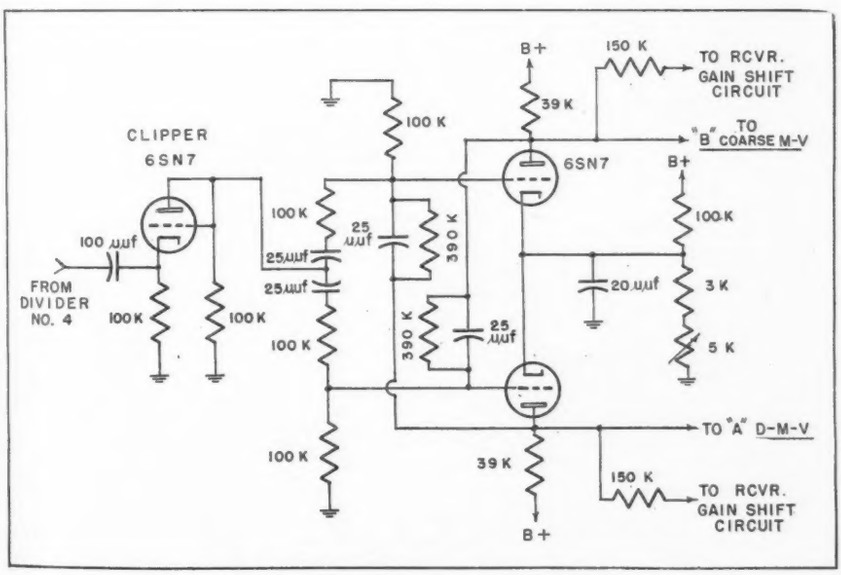


Fig. 10—Eccles-Jordan square wave generator

With the above review of a few of the elements of Loran the requirements for a Loran receiver-indicator may be formulated as follows:

(1) a *slow* time base, preferably linear, to examine the entire recurrence cycle (40,000 microseconds.);

(2) a *fast* or expanded time base (say, 200 to 2500 microseconds) to enable the identification of pulse train components and to permit a coincidence measurement of master and slave pulses;

(3) a *delay* circuit, which, by permitting one of the pulses to be delayed so that a coincidence measurement can be made, will result in a time difference reading equal to the delay;

(4) an *amplitude balance* scheme so that the two pulses, being necessarily slow rising, may be made identical in shape during measurement;

(5) an effective method for sweep calibration in order that the time difference can be read with the required precision and rapidity;

(6) a method of splitting the time base so that the pulse from one station may be brought under that of its mate for superposition;

(7) a method of identifying the recurrence rates of the station pairs in a positive manner;

(8) ample sensitivity in the receiver, perhaps to a microvolt;

(9) the receiver bandwidth should be wide enough to allow satisfactory discrimination of sky and ground wave components and yet narrow enough to keep adjacent channel interference at a minimum.

The entire idea of the Loran receiver-indicator is to permit the superposition of two originally unequal pulses of a Loran pair after they have been made equal in amplitude. During this matching process, the navigator introduces a delay into his equipment which is equivalent to the time difference of arrival of the two signals.

Typical receiver

The block diagram of a typical 1942 vintage receiver-indicator, the DAS-1 which has seen extensive service on board Allied ships, is given in Fig. 4, while the equipment is illustrated in Fig. 5. The circuit has been essentially preserved in later models of this same series. In the discussion of circuit operation which follows the individual blocks will be discussed, and the overall picture can be retained by referring each circuit back to the block diagram. The main elements of the DAS-1 are the crystal oscillator, the divider chain, the square-wave generator, the marker circuits, the receiver, and the amplitude balance circuit.

Since the 100 kc crystal oscillator is the local frequency standard, it must be sufficiently stable and adjustable for the received signals to remain stationary and have minimum drift across the screen, once the appropriate recurrence rate is selected. It is, as shown in Fig. 6, a conventional crystal-grid tuned-plate oscillator with some external plate-to-grid feedback for stable and vigorous oscillation and with capacity padding across the crystal in order to secure right and left drift. The squaring amplifier which also appears in Fig. 6 distorts the oscillator output sufficiently so that after differentiation, positive- and negative-going pips are derived to trigger the first of a series of dividers. The related waveforms are sketched in Fig. 7, and these should

be studied again after examining the divider operation.

Each divider, the first one is shown in Fig. 8, consists of a double-diode integrating circuit ("counter") and a triode blocking oscillator. The pips from the squaring amplifier are fed through a "bucket" capacitor and by the action of the diode the negative portion of the pips is removed so that only the positive pips pass on to fill the "cistern", or storage, capacitor in the grid circuit of the blocking oscillator.

The cathode voltage of the triode is adjusted by means of a potentiometer to a value which determines the number of bucketsful the cistern will receive before the conduction point of the triode is reached. Viewed at the grid of the blocking oscillator (see again Fig. 7) is a familiar stairs pattern displaying the discrete charges received by the storage capacitor; and the number of steps in the flight gives the division ratio for this stage. The inspection of this pattern on the cathode ray tube of the indicator allows the operator to check the division ratio of this stage, and this technic is used with the succeeding stages as well.

Deciding stages

The sharpness of the blocking oscillator output pips is dependent almost entirely on the design of the blocking oscillator transformer. Difficulties in the production of adequate divider chains for some Loran indicator models have resulted when these transformers were of inferior design.

The first dividing stage has a division ratio of 5:1. The succeeding stages whose circuits comprise Fig. 9 are all similar to the first stage except for the variation in division ratio. The second stage divides by 10; the third, by 5; and the fourth, by 8. (If a basic rate of 33⅓ per second is to be received, the fourth divider will divide by 6.) Since the oscillator operates at 100 kc., the output of the fourth divider will recur 50 times per second.

The fourth divider output drives the slow sweep generating circuit which is of the gas tube variety. (In other Loran sets a "hard" tube is used.) A paraphase amplifier resolves the sawtooth sweep voltage into two similar sawtooth voltages out of phase with each other. These are applied to the horizontal plates of the cathode ray tube to achieve a uniform sweep.

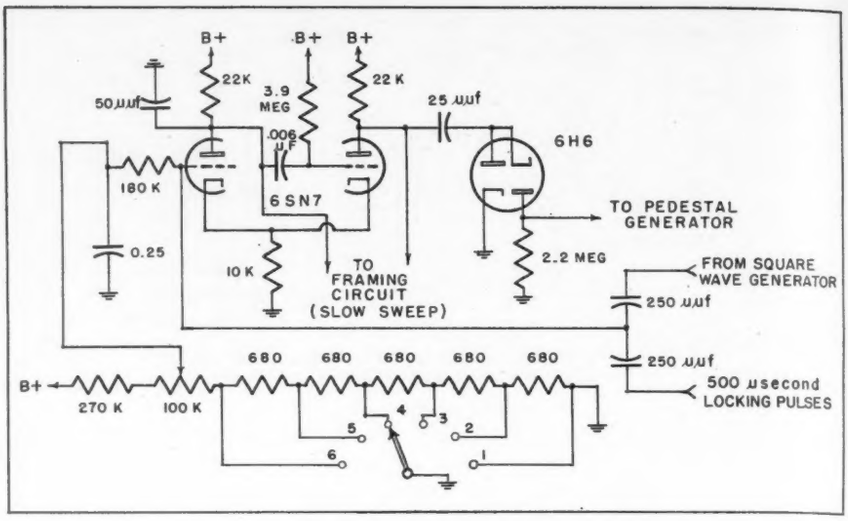
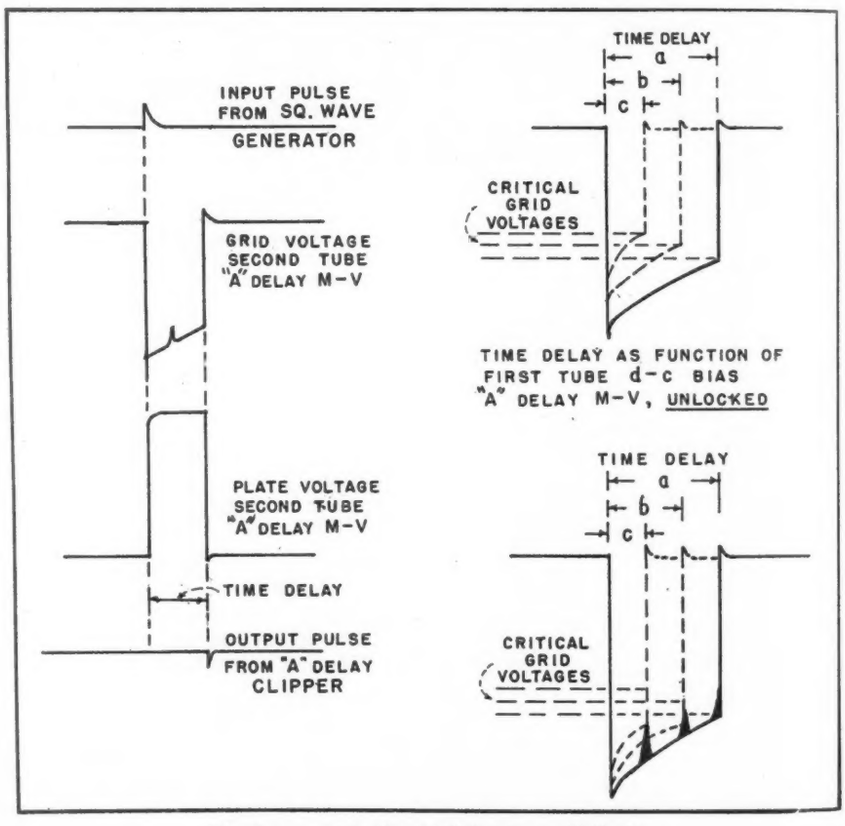


Fig. 11—"A" delay multivibrator



Waveforms and locking of "A" delay multivibrator

The split time base is achieved by the square-wave generator of Fig. 10, variously called "Eccles-Jordan," "scale-of-two," and "flip-flop" circuit.[6] This symmetrical circuit follows the last divider stage and furnishes a square wave occurring 25 times per second; thus, the total period of the square wave is exactly 40,000 microseconds. This square wave forms the reference for the A and B delay circuits, serves to initiate a controllable vertical trace shift on the oscilloscope, and drives the amplitude balancing circuit.

The A and B delay circuits are responsible for the accurate placement of signals on the slow sweep and for initiating the fast sweeps. The A delay circuit is simply a delay multivibrator driven by the differentiated output of the rising portion of the Eccles-Jordan square wave. It provides a trigger for the generation of a pedestal which will

6. Reich, H. J., Theory of Electron Tubes, P. 206, McGraw-Hill, New York, 1939.

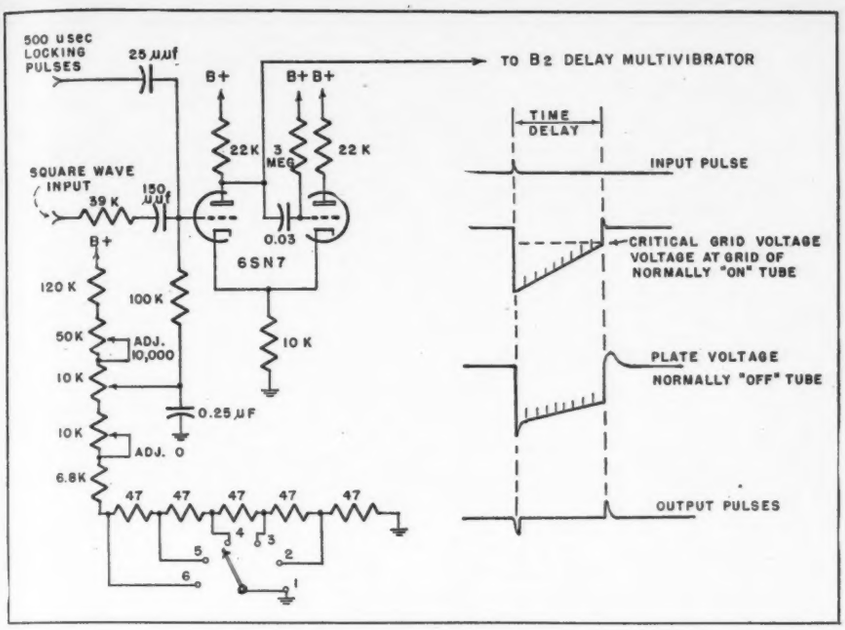
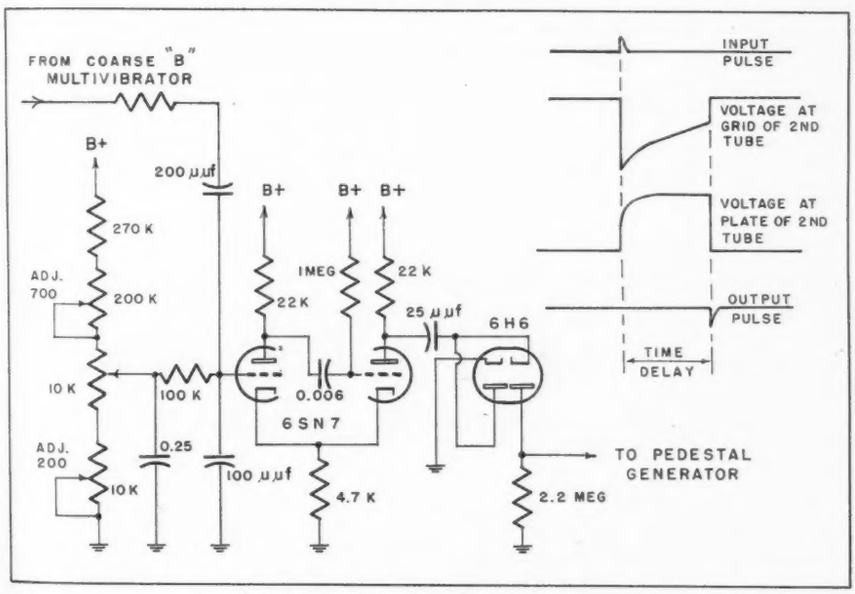
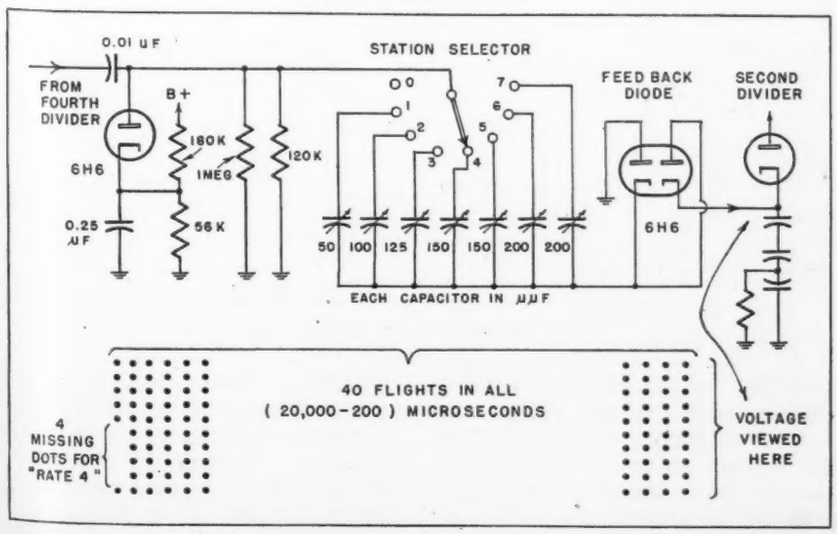


Fig. 12—"B" coarse delay circuit and waveforms



"B" fine delay circuit and waveforms

Fig. 13—Feedback circuit



occur some time after the start of the square wave and hence after the beginning of the slow sweep. In making a Loran reading, the master signal is always set astride the A pedestal. The A delay is maintained at a fixed value by being locked a few thousand microseconds after the start of the sweep. (Fig. 11)

The B delay circuit shoulders the burden of measuring the time difference in microseconds. Since the time difference to be measured will vary from the minimum to the maximum observable for a given pair of stations, a range of about 10,000 microseconds is absolutely essential. For example, if a 600-mile base line were used and the usual coding delay of 1,000 microseconds used at the slave, a reading of approximately 8,200 microseconds would be obtained on the master baseline extension, and this must be read to within one microsecond. This imposes rather strict conditions upon the B delay circuit.

In practice, stability is achieved by running the B delay as two delay multivibrators in cascade (Fig. 12), the first being adjustable in intervals of 500 microseconds out to 10,000, and the second being continuously adjustable over a range of 600 microseconds about the position established by the first. This results in two knobs being presented to the navigator—a coarse and a fine delay.

Delay multivibrator

The continuously adjustable delay multivibrator must be extremely stable and absolutely free from jitter; hence, plate decoupling is essential. The total action of the B delay circuit results in a pedestal which is variably delayed beyond the start of the second half of the Eccles-Jordan square wave, i.e., the beginning of the lower trace.

The selection of appropriate station pair is ingeniously accomplished by "feedback" in the divider chain, as indicated in Fig. 13. Loran recurrence rates bear the ratio 400:399:398 . . . 393 in the 25 per second family.

Thus, if the divider chain output occurs 50 times per second, the pips will be spaced 20,000 microseconds apart. To obtain the other recurrence rates, integral fifties of microseconds must be eliminated in the divider chain. The output of the fourth divider is fed back

through a diode, and the positive pip which results is delivered to the second counter storage capacitor — where it is combined with the pips entering from the first divider. For each count of the fourth divider, the second divider has counted 40 times.

This may be best pictured by imagining 40 flights of stairs (10 steps per flight) occurring between each fourth divider output pip. In one of these flights, the one displayed immediately after the instant of the fourth counter output, the fedback process removes one step. This flight thus has only nine instead of ten steps. Since each step is worth 50 microseconds, the entire interval is shortened by that amount. As more voltage is fed back (depending on the value of feedback capacitor) more steps are removed in this flight, until a maximum of 7 steps have been removed; there are therefore 39 normal flights, and one shortened flight. If the basic recurrence rate (no feedback) be designated "0," the remaining rates are specified by the number of steps removed, so that 7 "station" rates are possible for each basic rate.

Pedestal generator

The outputs of the A and B delay circuits are suitably clipped and mixed to give two trains of negative pulses of adjustable spacing. These pass on to the pedestal generator circuit of Fig. 14, a cross-coupled asymmetrical multivibrator of the delay type, which delivers a flat-topped pulse whose length is adjusted by the "fast sweep" switch. The timing relations of the divider chain, square wave generator, delay circuits and pedestal are exhibited in Fig. 15.

The fast sweep circuit generates a single, fast, linear, sawtooth wave each time the pedestal generator is triggered by the A and B delay circuits. The pentode of Fig. 14, with its usual characteristic of passing constant current, is placed in the cathode circuit of a triode. The grid of the triode is connected to the plate of one section of the pedestal generator. When a trigger from the A or B delay circuit reaches the pedestal generator, the plate potential of the first section falls, thus cutting off the triode in the fast sweep circuit.

Since the pentode plate is connected to the cathode of the triode, its current will drop, but only as

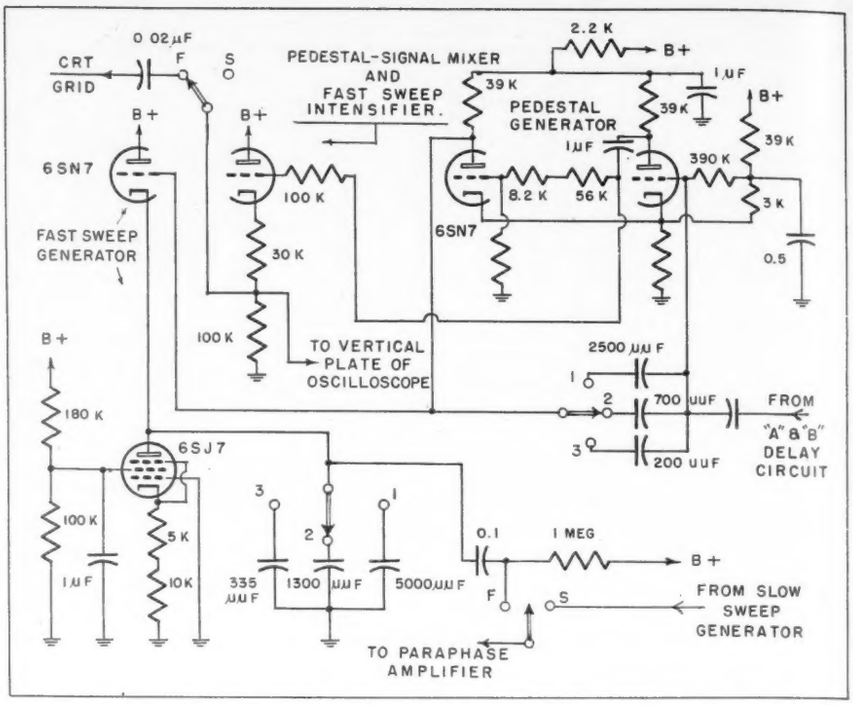


Fig. 14—Fast sweep and pedestal generators

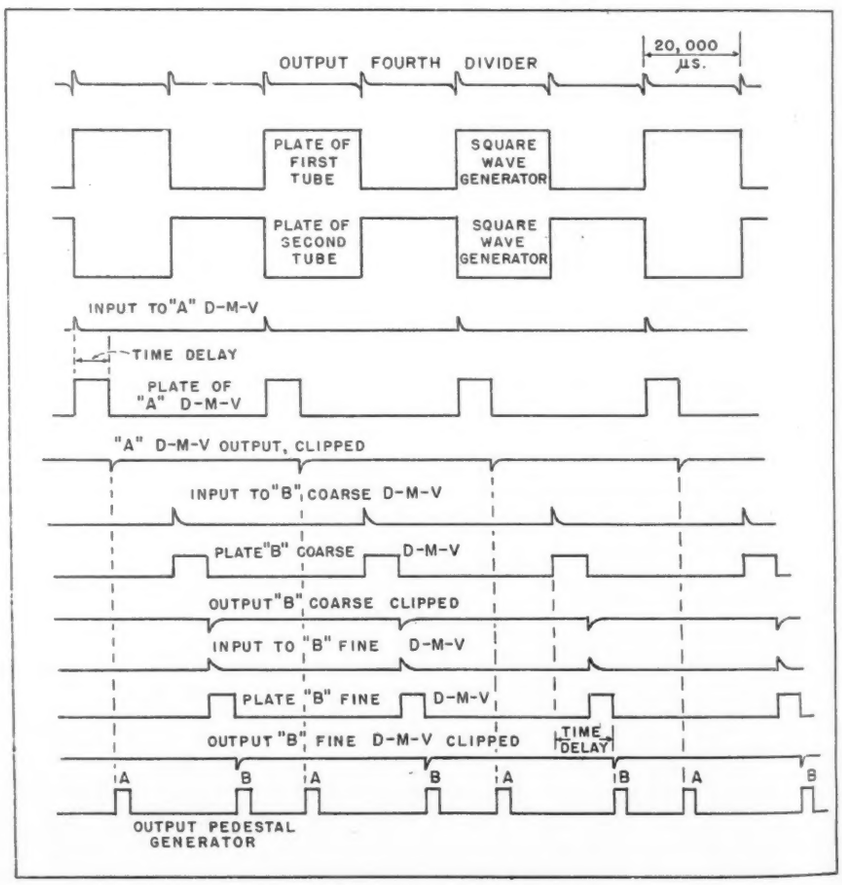


Fig. 15—Timing relations in delay circuits

permitted by the capacitors in its plate-cathode circuit while they leak off through the pentode. Thus the voltage on the pentode plate decays linearly with time and is applied to the grid of the paraphase amplifier. The voltage decay will cease abruptly when the pedestal generator returns to its quiescent condition, for then the triode conducts and the pentode capacitors are recharged. It is obvious that,

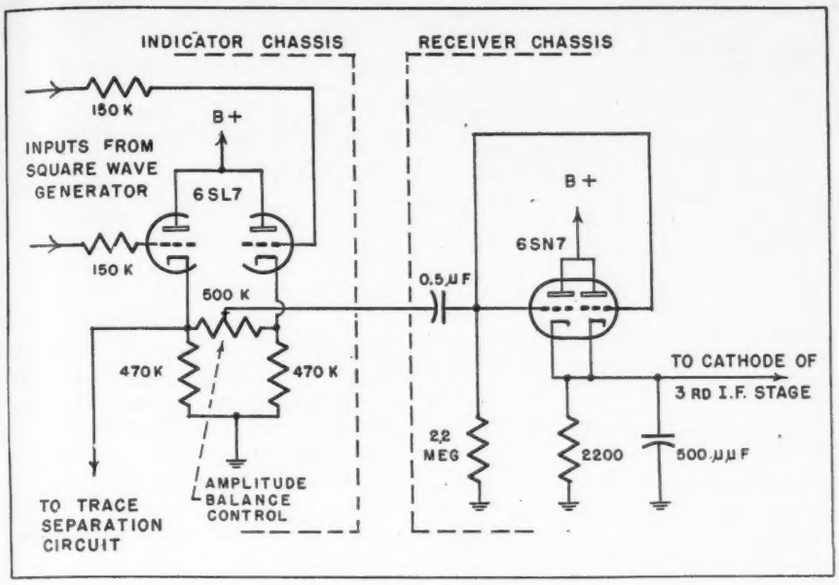


Fig. 16—Receiver gain-shift circuit

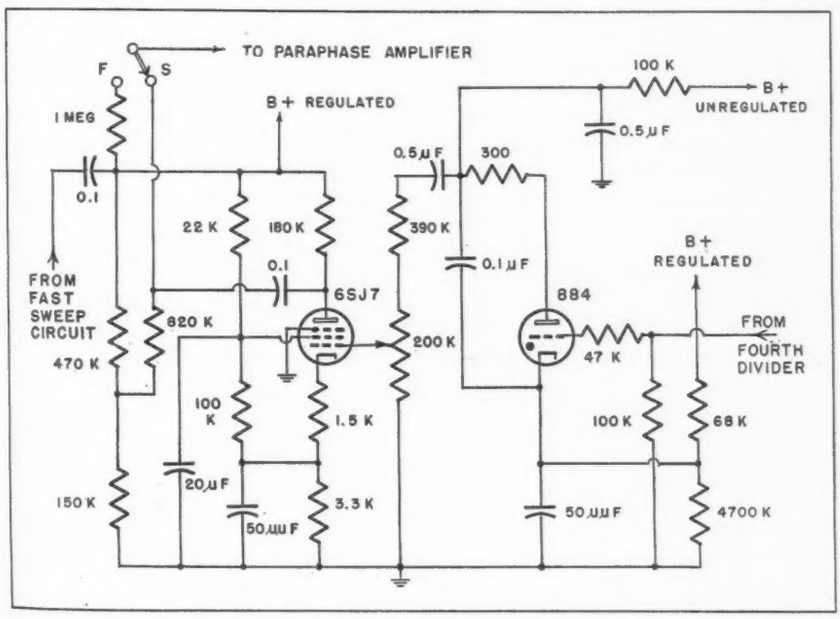


Fig. 17—Slow sweep generator

Fig. 18—Paraphase amplifier

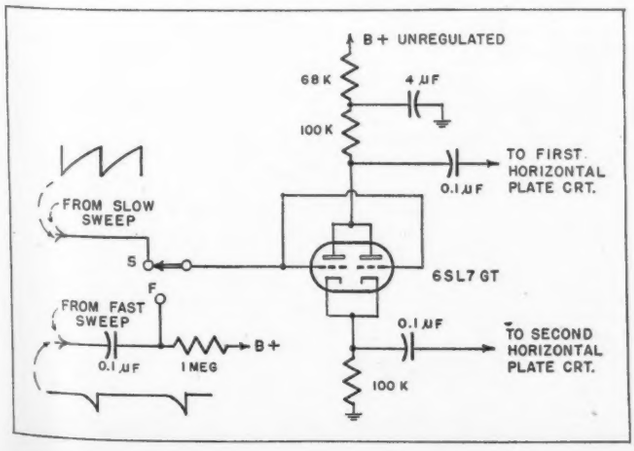
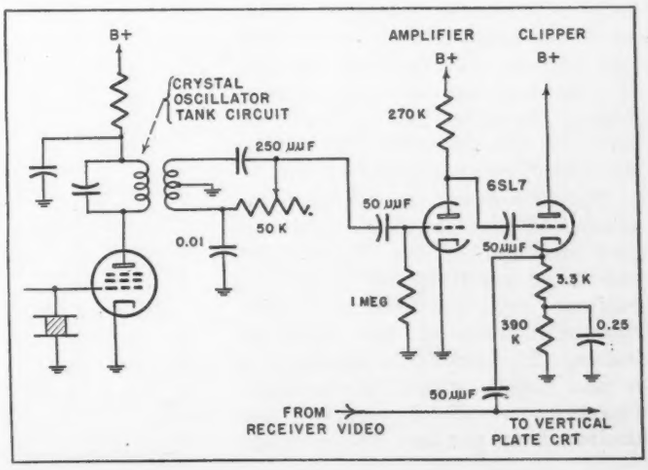


Fig. 19—10-microsecond marker circuit



if the fast sweep is to be linear, the size of the capacitors in the pentode circuit must be adjusted to give linear decay over the period during which the pedestal generator is active.

When the slow sweep is in use, the pedestal generator output is mixed with the receiver output, since pedestals and signals both appear as vertical deflections. The positive pedestal from the generator is applied to the grid of a 6SN7 pedestal-signal mixer triode, also shown in Fig. 14. The output of this cathode follower is switched to one oscilloscope vertical plate. Since the receiver output appears across part of the cathode load, the size of the pedestals will change as the receiver output is connected or disconnected. When the fast sweep is used, the cathode follower output is connected solely to the grid of the oscilloscope through a capacitor. During the part of the sweep cycle other than the fast sweeps, this serves to blank out the traces.

The gain-shift circuit of Fig. 16 gives independent receiver gain control during the A and B traces, so that the operator may match two signals of differing intensities by equalizing their amplitudes. The main receiver gain adjusts the amplitude of the weaker signal to a desirable size, while the amplitude balance is used to reduce the size of the stronger to that of the weaker one. One portion, the amplitude balance bridge, is in the indicator unit, while the 6SN7 cathode follower which alters the gain of the if stage is in the receiver chassis.

The amplitude balance bridge contains two cathode followers, driven in push-pull by the plates of the Eccles-Jordan circuit. The

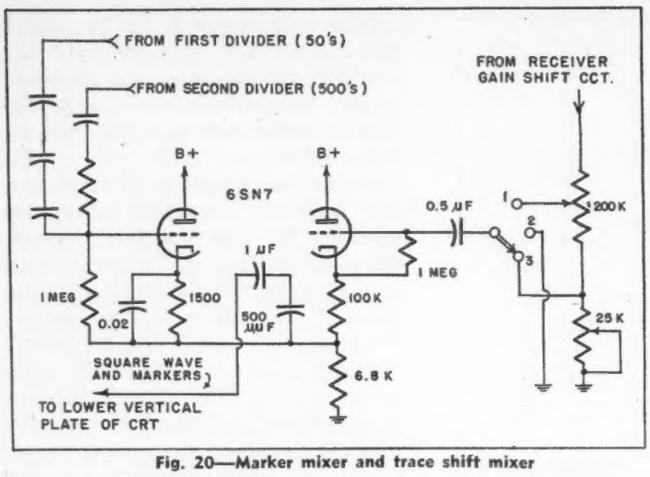


Fig. 20—Marker mixer and trace shift mixer

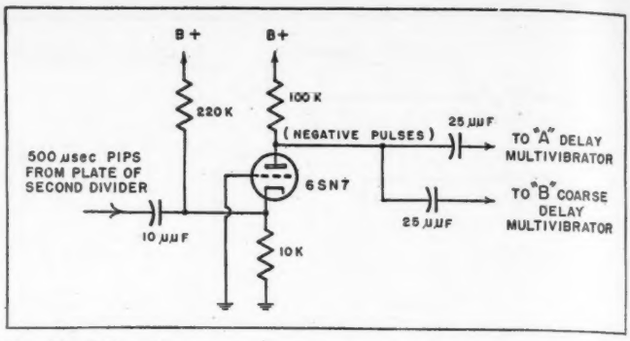


Fig. 21—500 - microsecond locking amplifier

cathodes are bridged by the amplitude balance control. During the A trace, one cathode is held at about 230 volts positive while the other is kept at about 80 volts positive by the square wave generator. This condition is reversed during the B trace period. At some point near the middle, the amplitude - balance potentiometer arm will settle at 150V above ground. If the potentiometer setting is altered, a square wave of variable height will appear, where the height is linearly dependent on the potentiometer rotation from the balance point. The phase of this square wave will reverse when the balance point is crossed.

The output of the variable arm is capacitatively fed to the joined grids of the cathode follower in the receiver, which consists of two triodes in parallel. The common cathode resistor is also the cathode resistor for the receiver's last if stage. The cathodes of the follower are driven up and down by the applied square wave, thus increasing and decreasing the gain of the last if.

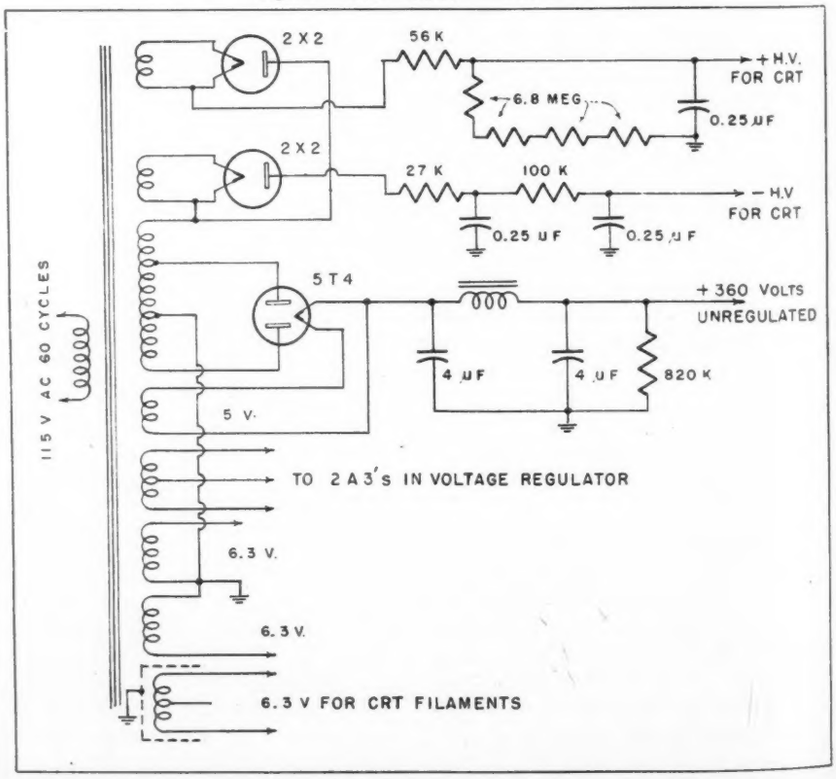
Actually, the gain of the last if cannot be increased much above that obtainable with the arm of the amplitude balance control at the balance point, for the cathode-follower cathode potential cannot be driven below that determined by the current flow through the last if tube and the cathode resistor. During the other half of the cycle, however, the receiver gain can be decreased by approximately 40:1.

The slow-sweep generator, consisting of the sawtooth oscillator and amplifier of Fig. 17, provides the linear sweeping voltage for the cathode ray tube which enables synchronization of the received pulses. The sawtooth oscillator is a gas triode which is normally biased to cut-off. A positive pulse derived from the last divider stage and occurring every 20,000 microseconds fires the grid. The plate cathode capacitor is discharged very rapidly through the tube until the tube is non-conducting, since by this time the initial pulse has been removed. The capacitor then charges slowly and essentially linearly through the resistor connected between it and B+. As the linear portion of the charging cycle is about completed another tripping pulse from the divider stage causes the cycle to be repeated. The charging portion of the cycle occupies about 19,930 microseconds. The discharge takes place in about 70 microseconds and this is the duration of the "flyback" time of the slow sweep.

A small fraction of the plate voltage swing of the gas triode is coupled to a pentode amplifier whose very linear output is delivered to the paraphase amplifier, shown in Fig. 18. Upon delivery to the paraphase amplifier, the sawtooth waves from the fast- or slow-sweep generator are transformed into push-pull sawtooth waves which are applied symmetrically to the horizontal plates of the cathode ray tube. The paraphase amplifier is a phase-splitting device and allows the input wave form to be amplified by a factor of two by the time it reaches the oscilloscope without altering the average horizontal centering voltage.

While the slow sweep sawtooth wave which is impressed upon the paraphase amplifier is positive, the fast sweep wave consists of a short duration negative sawtooth with a long interval of steady voltage. Consequently the grids of the paraphase amplifier are kept at B+ when the fast sweep is being used so that there will be ample oppor-

Fig. 22—Power supply; indicator unit



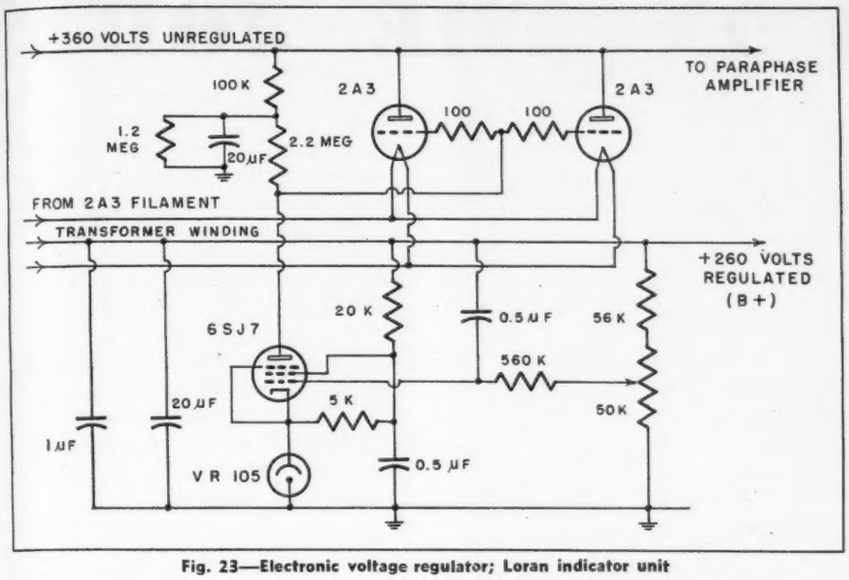


Fig. 23—Electronic voltage regulator; Loran indicator unit

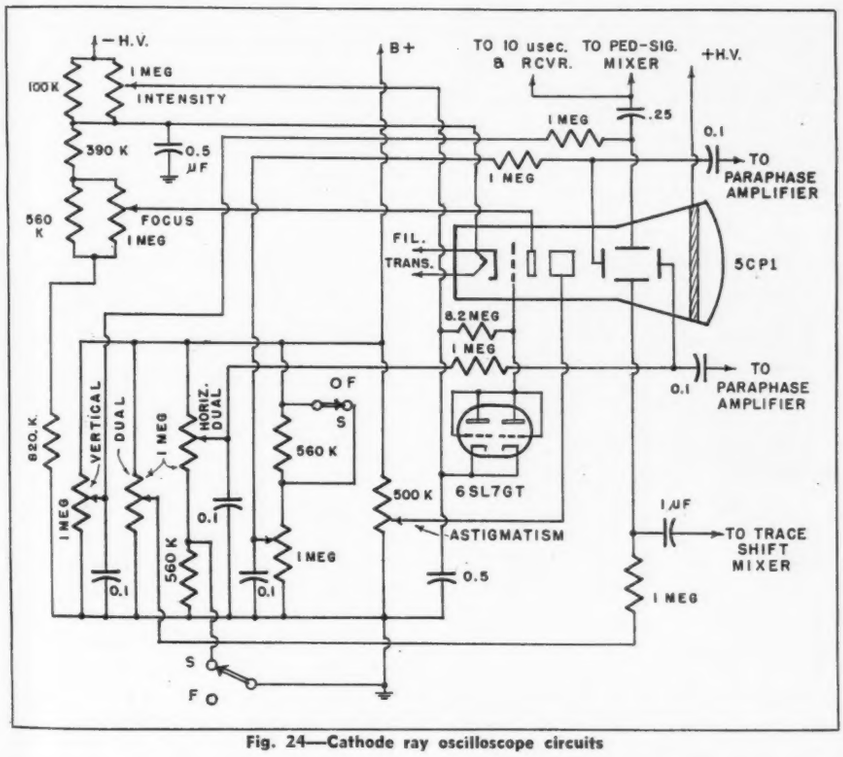


Fig. 24—Cathode ray oscilloscope circuits

tunity for the grid to respond to the range of the fast sweep drive.

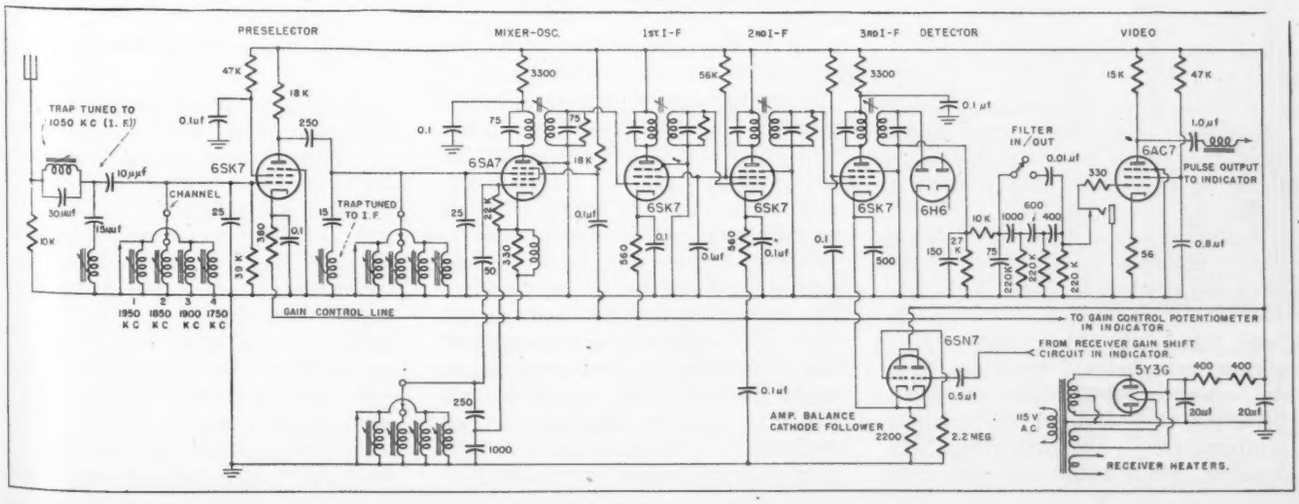
Markers are derived from the divider chain at almost every stage in order that the time base, both fast and slow, may be calibrated. Once a match has been made with the pulses of a Loran pair it becomes necessary to remove the signals and read the marker displacement upon the screen to a precision of approximately 1 microsecond. Usually, all Loran time differences are four-digit numbers, and the units used in tallying are 10's, 50's, 500's, and 2500's. The last digit, therefore, is obtained by interpolating a 10 microsecond segment upon the cathode ray screen.

Ten-microsecond markers are derived from the crystal oscillator. Since the oscillator output is a sine wave of moderate amplitude, it is amplified (the circuit is given in Fig. 19), and then, by means of a clipper, the sine wave peaks are converted to sharp symmetrical pulses about 2 microseconds long. By means of the phase shifting network which couples the crystal oscillator output to the 10 microsecond marker circuit, every fifth 10 microsecond marker is made to coincide with one of the 50 microsecond markers from the marker mixer circuit.

Marker Mixer: The marker mixer combines the output of the first and second divider stages. The size of the coupling capacitors of Fig. 20 which draw off the marker pulses from the divider are adjusted so that the 500 microsecond pulses (from the second divider) are several times larger than the 50 microsecond pulses. Both sets of pulses are applied to the grid of a self-biased cathode follower which acts as a clipper. A larger

(*Continued on page* 126)

Fig. 25—Complete wiring diagram of the receiver unit



TUBES ON THE JOB

Control for Electric Heat

The accurate control of temperature in a 75 KVA re-circulating type electric furnace used for annealing steel stampings, has in the past proven a troublesome problem at the Commercial Metal Treating Co., Bridgeport, Conn. This furnace is not only used for annealing at different temperatures but in many cases a single temperature must be maintained for successive batches of work which differ greatly in weight. These two factors plus the desirability for economical use of power prescribe requirements that make the effective operation of a heat control unit extremely difficult.

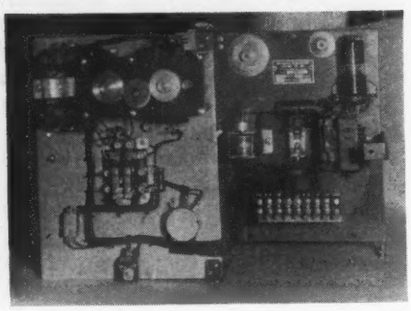


Fig. 1—Electronic relay in controller unit

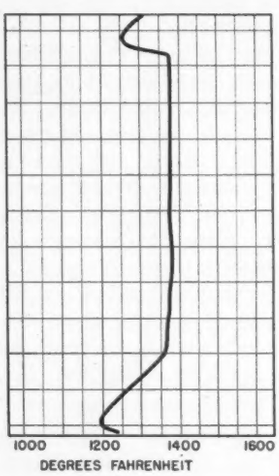


Fig. 2—Chart A. Heat control by ATC unit

A new electronic balancer input controller made by Automatic Temperature Control Co., Inc., 34 E. Logan St., Philadelphia 44, Pa., has been fitted into this picture and is giving satisfactory results. This unit operates on the most advanced principle for control of furnace temperature — proportioning plus floating. Fully automatic operation is accomplished at a rate dependent on the degree of temperature variation from a control point setting on a pyrometer.

There are no saturable core reactors or control resistors in this system, the current being fed to the furnace either full "ON" or "OFF". Basically, this ATC controller is built around a Wheatstone bridge circuit and an electronic relay unit (Fig. 1). When an unbalance is set up by the slightest change of temperature in the furnace it is detected by the sensitive electronic circuit and the time periods for which power is applied to the heating elements are accurately corrected.

For all periods that the furnace temperature is more than five per cent plus and minus from the control setting, the power is "ON" or "OFF" continuously until the furnace comes within this narrow throttling range. At that time the heating circuit is alternately closed and opened at proper proportionate intervals so that the power delivered will bring the furnace to the correct heat setting without overshoot and from then on will compensate for the heat absorption of any particular furnace load. As the heat requirements vary because of the difference in load weights, so these proportionate on-off periods are increased or decreased by an automatic load compensator to take care of these larger or smaller furnace charges. There are two other features in this electronic heat control which are engineered for economy of power in maintaining proper furnace temperature and for convenience in showing the saturation temperature in the furnace; the maximum input switch effectively avoids temperature overshoot and the visual indicator light that shows the percentage of power input to the furnace and is illuminated during the power "ON" cycle only.

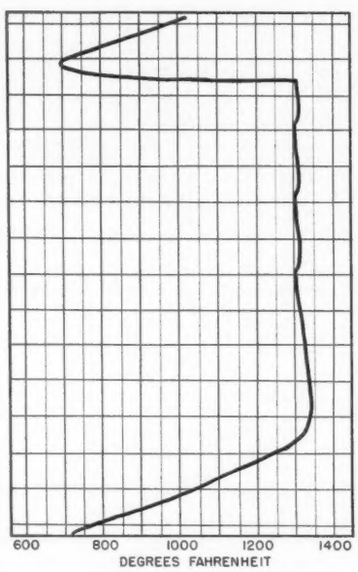


Chart B. Control by ordinary throttling unit

The increased accuracy of this new unit is shown by the recordings. Chart A of Fig. 2 gives the electronic balancer input controller's results in a typical run at the Commercial Metal Treating Co., with control point set at 1380°F. There is no overshoot and the temperature is exact. Chart B records a run of identical work through the same furnace when equipped with an ordinary throttling type input controller, previously installed here, with control set at 1300°F; a 40° overshoot occurs and the furnace heat rises and falls in wave like

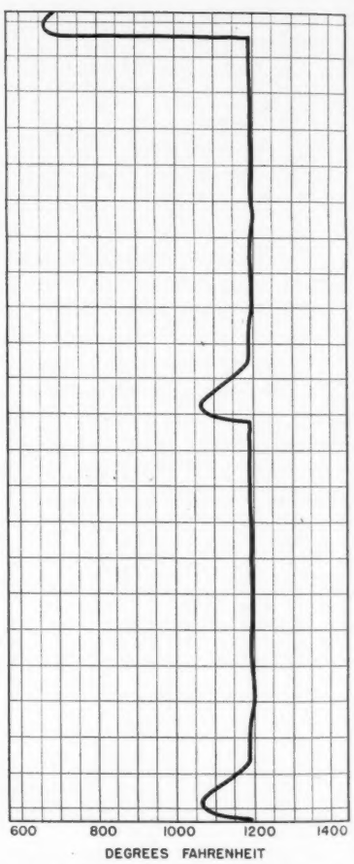


Chart C. Furnace heat recording for two loads

drifts. It hits the set value of 1300° at only four short intervals. Chart C is the furnace temperature as controlled by the electronic balancer during the annealing operations for the two loadings shown in

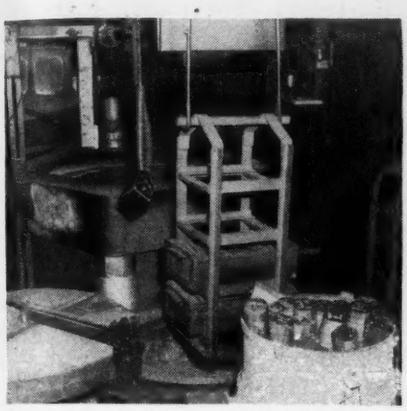


Fig. 3—75 KVA electric furnace in left center

Fig. 3, one of these weighed 913 lb. and the second, the load which is on the lifting yoke, weighed only 420 lb. For both operations the control setting was 1195°.

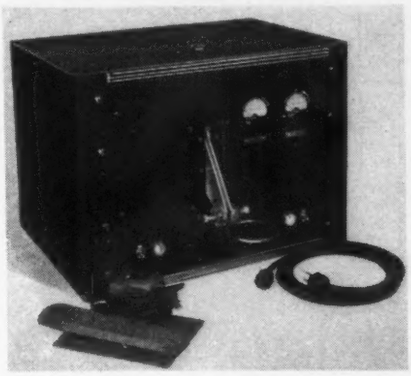
Induction Soldering Unit

A portable bench type induction soldering unit developed jointly by Marion Electrical Instrument Co. and Polytechnic Research and Development Co., New York, was designed for fabricating Marion glass-to-metal hermetically sealed instruments and has now been placed on the market. The unit consists of a self-excited rf oscillator operating at approx. 450 kc and uses a low impedance link for transfer of rf energy to the work coil thus avoiding the use of tuning devices. The link is provided with a grounded center tap so that the operator is not exposed to voltages which would produce shock or burns. Operation is from the 60 cycle, 115 volts ac power line. The unit consumes 775 watts at full power output and approx. 100 watts at stand-by.

Two switches are provided on the front panel. One switch controls the filament voltages and the other the high voltage to the oscillator tubes. A foot treadle type switch instead of the toggle switch for controlling operation may be used. Some suggested applications are: Metal-to-metal soldered assemblies, small soldered seams, metal to metallized-glass assemblies, metal to metallized ceramic assemblies and small radio and radar components. Higher efficiencies result, when the material to be heated has high resistivity. By use of induction heating the speed of soldering operations in increased, cleaner work and greater uniformity with few rejects is achieved, since precise control of the temperature cycle is possible. Oxidation and scaling, the damaging of the surface finish or the exposure of adjacent parts to damaging temperatures is avoided. Local heat may be applied to parts which are inaccessible to the soldering iron.

Above—The induction soldering unit is used here for hermetic sealing of electrical meter. By applying local heat to the face of the meter, a perfect glass-to-metal seal is achieved

Below—View of portable bench type induction soldering unit with associated equipment



Meat Preservation

The use of Disinfectaire ultraviolet germicidal lamps in meat storage refrigerators has helped reduce spoilage by retarding mold growth and contamination. Higher temperatures and humidities are permissible and this reduces weight loss by moisture evaporation. This germicidal equipment is made by Art Metal Co., Cleveland 3, Ohio.

MILK CAN STERILIZER

A new U shaper Sterilamp that can be placed in a washed milk can just before filling, will kill 96% of bacteria count with only a sixty-second exposure. These Westinghouse Sterilamps are suspended on springs inside a protective cage and have a long service life even under constantly severe working conditions

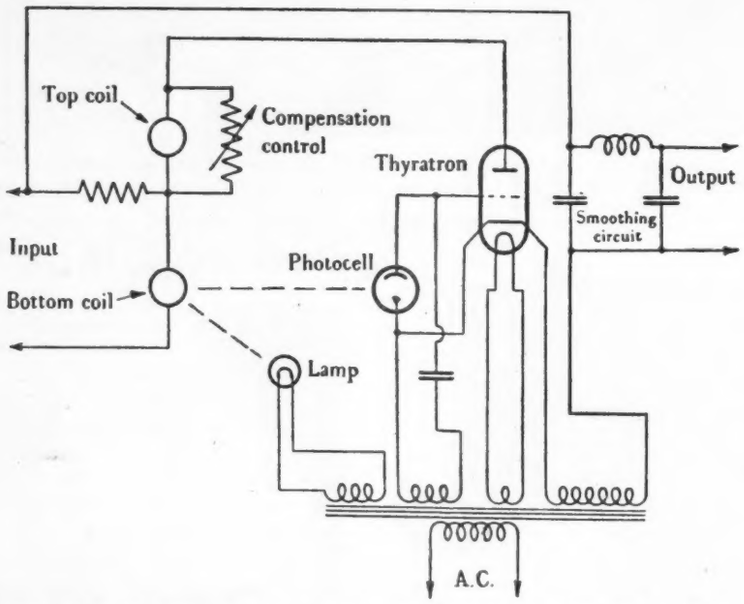
SURVEY of WIDE READING

Electronic news in the world's press. Review of engineering, scientific and industrial journals, here and abroad

Sensitive Galvanometer Amplifier

By D. C. Gall and H. Tinsley (Journal of Scientific Instruments, London, November, 1945).

The sensitivity of a galvanometer increases as the restoring force of the suspension strip decreases. However, the oscillation period of the instrument will simultaneously increase, making it tedious to use, and magnetic impurities in the coil will take control and the zero become unstable. To increase the sensitivity of a galvanometer without incurring these disadvantages a double galvanometer amplifier system illustrated in the figure has been devised.



Two different galvanometers are combined with thyratron in galvonometer amplifier

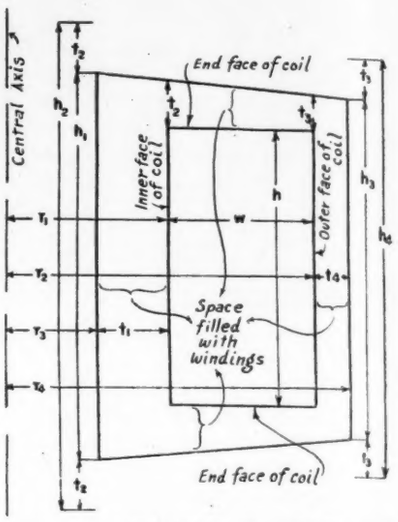
A sensitive galvanometer coil with a fairly short natural period is suspended from another but stronger galvanometer coil above it, so that the zero of the bottom coil is controlled by the position of the top coil. Thus, when a small current is passed through the bottom coil, causing it to deflect, another current is passed through the top coil which, by turning the suspension strip, removes the restoring force acting on the bottom coil, so that the latter can deflect to a greater extent. The current through to top coil is made to depend on the current through the bottom coil by a mirror attached to the bottom coil which deflects a light beam onto a photocell in the grid lead of thyratron. Negative feedback is introduced to stabilize the circuit and to provide a high effective input resistance. A voltage proportional to the current in the top coil or output circuit is applied to the input circuit of the bottom coil. The effect of this is to control the deflection of the bottom coil so that it takes up a final position where the negative feedback voltage equals the input voltage.

The deflection of the top coil is used as the indication of the very small applied input voltage to the bottom coil. The circuit may be rearranged to operate as a current amplifier instead of as a voltage amplifier.

Self-Inductance of Toroidal Coil

H. B. Dwight (Electrical Engineering, November, 1945).

The self-inductance of a toroidal coil of rectangular cross-section and without iron is computed. The many-layer winding is assumed to fill the air-space densely. Consequently, the thickness of the wire layers on the inner side of the coil facing the central axis (t_1) is greater than the thickness of the wire layers on the outer face of the coil (t_4). The final expression for the self inductance is



Cross-section of toroidal coil explaining symbols in the expression for self-inductance

$$L_{\text{abhenrys}} = 2hN^2 \log \frac{r_2}{r_1}$$

$$+ 2\pi^2 n^2 \left[(h+qr_1)\left(r_3^4 \log \frac{r_1}{r_3} - r_3^3 l_1 + \frac{1}{2} r_3^2 l_1^2 + r_3 l_1^3 + \frac{1}{4} l_1^4 \right) - q l_1^3 \left(\frac{4}{3} r_3^2 + r_3 l_1 + \frac{1}{5} l_1^2 \right) \right]$$

$$+ \frac{4N^2}{3} \left[\left\{ t_3 + \frac{r_2(t_2-t_3)}{r_2-r_1} \right\} \log \frac{r_2}{r_1} - (t_2-t_3) \right]$$

$$+ 2\pi^2 n^2 \left[(h-q_1 r_2)\left(\frac{4}{3} r_4 l_4^3 + \frac{1}{5} \frac{l_4^5}{r_4} + \frac{1}{6} \frac{l_4^6}{r_4^2} + \dots \right) - q_1 l_4^3 \left(\frac{4}{3} r_4^2 - r_4 l_4 + \frac{1}{5} l_4^2 \right) \right],$$

where

N = number of turns in the coil,

log$n$ denotes natural logarithm,

n = density of turns per square cm,

$$n = \frac{N}{\pi(r_1^2 - r_3^2)} = \frac{N}{\pi(r_4^2 - r_2^2)},$$

$$q = \frac{h_2 - h}{t_1},$$

$$h_2 = h_1 + 2t_2, \quad h_1 = h + 2\left\{ t_3 + \frac{(w+t_1)(t_2-t_3)}{w} \right\},$$

$$t_2 = \frac{N}{2\pi r_1 n}, \quad t_3 = \frac{N}{2\pi r_3 n},$$

$$q_1=\frac{h_4-h}{t_4}\ ,$$

$$h_4=h_3+2t_3\ ,\quad h_2=h+2\left\{t_2-\frac{t_4}{w}(t_2-t_3)\right\}$$

The first term in the equation for the self-inductance represents the self-inductance of a one-layer coil, the second, third and fourth lines represent the contribution by the inner trapezoid of thickness t_1, the fifth line that of the two trapezoids at the ends of the coil of varying thickness (between t_2 and t_3), and the last two lines that of the outer trapezoid of thickness t_4. Dimensions are as indicated on drawing; r_3 and r_4 can be computed from the equation for n which is available for a given size wire.

High Dispersion Electron Diffraction

G. L. Simard, C. J. Burton, and R. B. Barnes (Journal of Applied Physics, December, 1945)

Electron diffraction has often been limited in its usefulness by its inherently low dispersion for high values of lattice spacings. The portion of the diffraction pattern corresponding to these long spacings occurs at small angles with the undiffracted beam. The rapid decrease in dispersion with increase in the distance between diffracting planes sets the usable upper limit of lattice spacings with present diffraction systems at about 5 Angstrom. Although sufficient for the study of most inorganic materials, such a 5-Angstrom limit is entirely inadequate for the majority of organic crystals where planar spacings of 10 to 30 Angstrom frequently occur. Not only is the measurement of longer spacings inaccurate, but often the resolution of closely lying reflections is difficult because of the finite line width and broadening of the recorded reflections by scattering within the photographic emulsion.

A method for attaining high dispersion in electron diffraction is presented. This method involves magnification of the diffraction pattern before the electrons strike the photographic plate. The degree of dispersion may thus be varied continuously; it is limited essentially only by the resolution of the original pattern. Suitable lens systems are described, particularly with a view to use a diffraction adapter for electron microscopes.

Amplitude-Modulated Pulse System

F. F. Roberts and J. S. Simmonds (Wireless Engineer, London, November and December, 1945)

Following a survey of various multichannel communication systems which make use of modulated pulse chains and considering their characteristics in some details, an experimental apparatus using amplitude-modulated pulses is described which provides seven good quality speech channels within a band of 110 kc. In all the systems considered, the whole of a relatively large frequency band is made available for consecutive small time intervals to each of the individual channels in cyclic order.

Transmitter

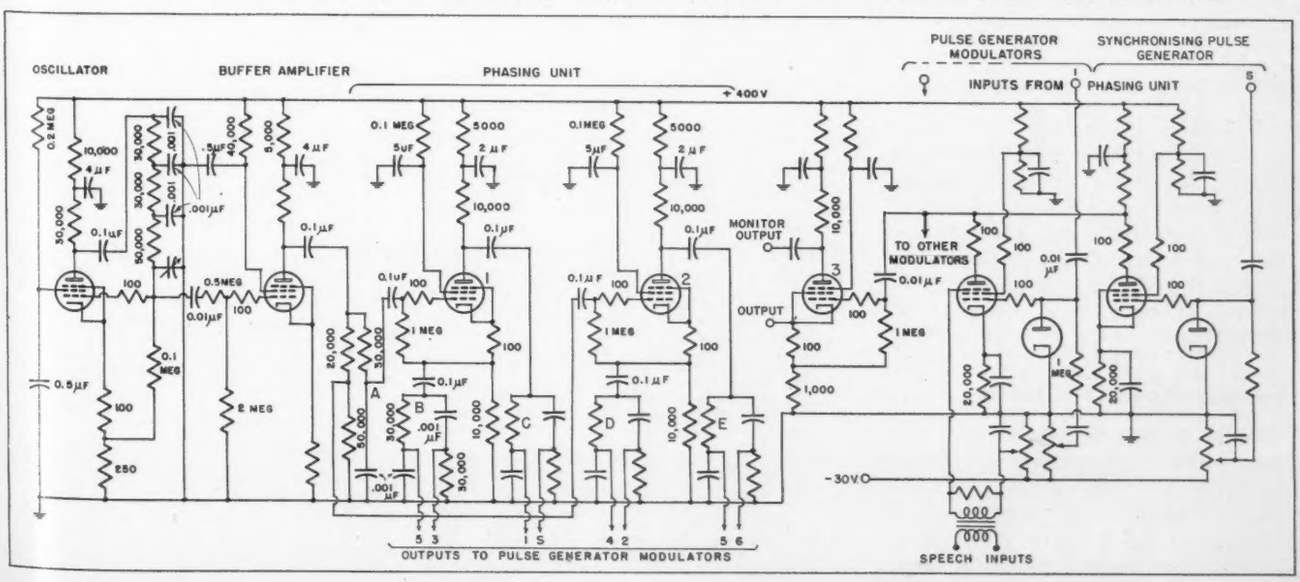
The sinusoidal, 8 kc output of a conventional resistance-capacitance type oscillator is amplified in a buffer stage. Eight pulse chains spaced at equal time intervals, i.e., 45 degrees from each other, are required for the seven channels transmitting intelligence and the synchronizing signal channel. Eight phase-shifted sinusoidal waves are derived from the oscillator output by phase shifting networks.

The buffer amplifier output is separated into two parts, one of which is shifted in phase by 45 deg. in phase splitting network A; the two parts are made the inputs to tubes 1 and 2 respectively. The use of tubes rather than transformers was indicated by the improved phase stability and lower circuit impedances possible while maintaining the desired high voltage level. The four outputs at the cathodes and plates of tubes 1 and 2 are further passed through four identical phase splitting networks B, C, D, E, delivering eight sinusoidal waves of at least 30 volt peak amplitude displaced by 45 deg. with respect to one another to terminals 1 to 7 and S. In the drawing, two terminals are erroneously marked 5, the one on the extreme right should be 7.

These eight sinusoidal voltages control the generation of the eight equally spaced pulse chains in the pulse generator section; only one unit and the synchronizing unit are represented in the drawing. Pulse generation relies upon the approximately exponential plate current vs. grid voltage cut-off characteristic of the pentodes used. The first grids are negatively biased so that they are at a negative potential even at the peak of the superposed signals at terminal 1 from the phasing circuits; the bias is stabilized by the diode in the grid lead.

(*Continued on page* 134)

Circuit diagram of experimental, amplitude-modulated pulse system. The seven communication channels are transmitted consecutively



NEWS OF THE INDUSTRY

Chicago Parts Show Scheduled For May 13-16

Manufacturers are readying exhibits for the Radio Parts and Electronic Equipment Show scheduled for the Hotel Stevens, Chicago, for the four days, May 13-16. The exhibition, which will be limited to radio parts, electronic equipment, service tools and equipment regularly handled by radio parts and electronic equipment distributors, will contain no complete receivers, phonographs or other electronic equipment.

The venture is under the joined sponsorship of the Association of Electronic Parts and Equipment Mfrs., Parts Division of Radio Mfrs. Association, the Sales Managers Club (Eastern division) and the National Electronic Distributors Association. The exhibition hall of the Stevens hotel has been arranged to permit a total of 163 exhibits and it is expected that the show will attract a record attendance representing, as it does, the first exhibition of radio components (aside from the IRE exhibit in January) since before the war.

General management of the show is in the hands of a committee which is headed by H. W. Clough of Belden Mfg. Co., Chicago, and president of the Radio Parts and Electronic Equipment Shows, Inc. General manager of the show is Kenneth C. Prince who has established headquarters at 221 No. LaSalle St., Chicago. Exhibitors will be limited to those companies which are members of the four sponsoring organizations.

RKO Tele Elects Austrian

Ralph B. Austrian has been elected president of RKO Television Corp., succeeding Frederic Ullman, Jr. Ullman's duties as president of the greatly enlarged RKO-Pathe, Inc., are demanding practically all of his time. He will continue to serve, however, as a director of RKO Television Corp.

Cedar Rapids Elects

Cedar Rapids Section of IRE has increased its membership almost 200% during the past year and now boasts a total of 157 members and associates. T. A. Hunter has been elected chairman of the section, other officers being: Vice-chairman Prof. W. R. Abbott; Secy.-treas. Roger S. Conrad.

Federal Producing FM Transmitting Units

Federal Telephone and Radio Corp., domestic manufacturing affiliate of the International Telephone and Telegraph Corp., has entered the field of frequency modulation broadcasting equipment manufacturing. Federal is building FM broadcast transmitting equipment for 170 installations. Deliveries will be made starting the end of March, 1946. A number of stations have already been contracted for including one for the New York daily newspaper "The New York Post".

1500-Mile Coax Cable

Federal Communications Commission early in January granted an application for the largest single construction project ever considered by the Commission. This is an additional link in the proposed New York and Los Angeles 3287-mile coaxial cable to be installed by the American Telephone and Telegraph Co. and several of its affiliates. The link will cover about 1500 miles and the cable will contain eight coaxial units suitable for the transmission of television programs in addition to providing telephone and telegraph channels. The complete Bell System plan involves the installation of about 7000 miles of coaxial cable and it is expected that the program will be completed within the next four years.

FCC Sticks by Guns On FM Allocations

For the record, there won't be any change in FM allocations. As most everyone now knows, FCC stuck by its guns. After almost interminable hearings, the latest staged January 18 and 19, on a petition filed by Zenith Radio Corp., the commission definitely decided to leave FM in the 88-108 mc spot originally allocated. Hence, there is no need for two-band sets and the 42-50 mc section remains part of the television spectrum despite the fact that no one has asked for it and apparently none wants it.

It was to determine "Whether the band 42 megacycles to 50 megacycles, or any part of it, should be made available for FM broadcasting in addition to the assignment already made to FM in the 88 to 108 megacycle band" that the hearing was called. Major Armstrong, long an articulate opponent of the Army's Norton, largely responsible for FCC's decision to shift to the higher band, strongly supported Zenith in the contention that the neighborhood of 45 mc where FM has so long and so satisfactorily served, had demonstrated better service than would be possible at twice that frequency, the latter as yet untried. Many others, including General Electric's C. R. Miner, lined up with the lower frequency contingent. And eventually Zenith amended its original petition to ask only for the 44-50 band instead of the whole 42-50 mc No. 1 television channel.

However, no arguments that

Conventions and Meetings Ahead

Institute of Radio Engineers, New York Section (330 West 42nd Street, New York); "Television as used on guided missiles," March 6, Engineering Societies Building, New York.

Optical Society of America (A. C. Hardy, Mass. Inst. of Tech.); Mar. 7-9, Cleveland.

Institute of Radio Engineers, Chicago Section (135 So. LaSalle Street, Chicago 3, Ill.), March 15, April 19 and May 17.

National Association of Broadcasters (Bruce Starkey, Chief, News Bureau, 1760 N St., N. W., Washington 6, D. C.); Broadcast Engineering Conference, March 18 to 23, Ohio State University, Columbus.

American Chemical Society (Alden H. Emery, 1155 Sixteenth Street, N. W., Washington, D. C.); April 8 to 12, Atlantic City, N. J.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York); South West District Meeting, April 16 to 18, San Antonio, Tex., Northeastern District Meeting, April 21 to 25, Buffalo. Southeastern Dist. Meeting, May 13 to 16.

World's Invention Exposition (Exposition offices: 155 North Clark St., Chicago 1, Ill., Director: E. K. Green); April 11 to 22.

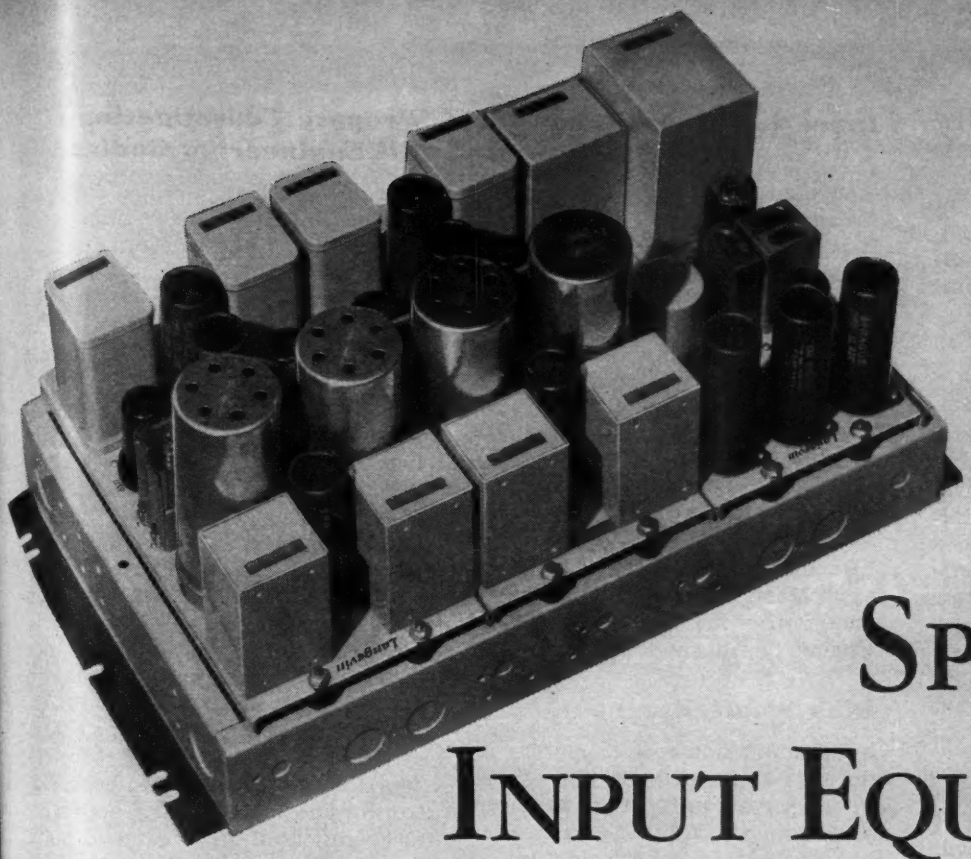
Society of the Plastics Industry (Barret L. Crandall, 295 Madison Avenue, New York 17, N. Y.); National Plastics Exposition, April 22 to 27, Grand Central Palace, New York, N. Y.

Radio Parts and Electronic Equipment Conference and Trade Show (Kenneth C. Prince, 221 No. LaSalle Street, Chicago, Ill.); May 13 to 16, Hotel Stevens, Chicago.

American Society for Testing Materials (260 South Broad Street, Philadelphia); Forty-ninth Annual Meeting, June 24 to 28. Buffalo, simultaneously, Seventh Exhibit of Testing Apparatus and Related Equipment.

American Institute of Electrical Engineers (H. H. Henline, 29 W. 39th Street, New York); Summer Convention, June 24 to 28, Detroit. Pacific Coast Convention. August 26 to 30, Seattle.

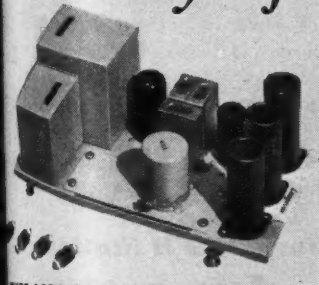
Instrument Society of America (L. Susany, Secretary, Carnegie Institute, 4400 Forbes Street, Pittsburgh); 1946 Exhibit and Conference, September 16 to 20, Pittsburgh.



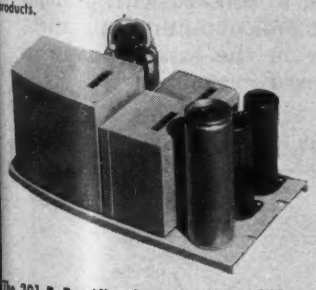
AT LEFT. Two Langevin Type 111-A Dual Pre-Amplifiers and one Langevin 102-A Line-Amplifier mounted on a 3-A Mounting Frame. This unit provides four pre-amplifiers and one line-amplifier, or three pre-amplifiers, one booster-amplifier and one line-amplifier, all in 10½" of rack mounting space. External power supply such as the Langevin 201-B Rectifier, as shown below, is required.

SPEECH INPUT EQUIPMENT

Worthy of an Engineer's Careful Consideration



TYPE 102A Amplifier is one of the 102 Series Line Amplifiers of which four different types are available. The "A" is mostly used to drive the line after the master gain control. It is quiet, has excellent frequency characteristic and ample power output with low distortion products.

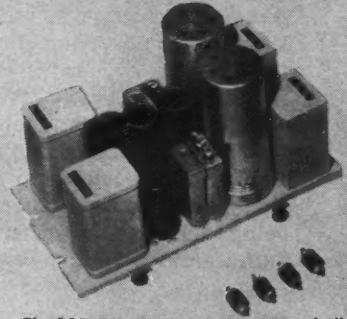


The 201-B Rectifier is one of the 201 Series Rectifiers, of which two types are available, the "B" having additional filtering, thereby giving a slightly lower ripple content than the "A." This unit is capable of supplying power for one 102 Series Line Amplifier and three 111 Pre-Amplifiers (six pre-amplifiers).

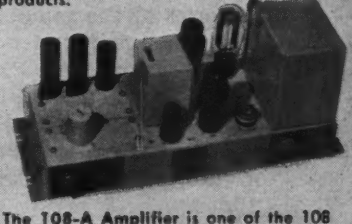
Every unit of Langevin speech input equipment is held to a rigid standard of performance. These units may be cascaded in accordance with good engineering practices and still be well within the allowable limits of FM requirements as to frequency response, noise and distortion products.

All Langevin speech input equipment units are mounted on standard 5¼" x 10¼" chassis. Three of these units can be mounted on a Langevin 3-A Mounting Frame, which occupies 10½" of space on any standard rack. Wall mounting steel cabinets for housing these units are also available.

We are proud of the products which bear the name ***Langevin***. It will only appear on good apparatus.



The 111-A Amplifier consists of two individual pre-amplifiers on a single chassis for use in high quality speech input equipment. Its compact unitized construction saves rack space. Input impedances of 30, 250 and 600 ohms; output impedance 600 ohms. It is quiet and has excellent frequency characteristics and ample power output with low distortion products.



The 108-A Amplifier is one of the 108 Series Monitor Amplifiers, of which four different types are available. The "A" is ordinarily used to drive a monitor system from a 600 ohm or bridging source. Its distortion is low for this type of service. It is quiet and has ample power with excellent frequency characteristics.

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could be marshalled by the lower frequency proponents could be made to carry enough weight to influence FCC. The decision to make no change was released without comment or engineering reason, which, FCC says, will be forthcoming somewhat later.

Hallicrafters' FM Converter

Simultaneously with the Federal Communication Commission's final settlement of the controversy over FM broadcasting channels, the Hallicrafters Co., Chicago, has placed in volume production a new low-priced converter which can be used to adapt prewar FM sets to the new band of 88 to 108 megacycles. Using a single tube and small enough to fit inside practically any FM set cabinet, the converter is priced to sell at $15.00 retail.

U. S. Television Moves

U. S. Television Mfg. Corp. will move from 106 Seventh Ave., New York 11, N. Y., to 3 West 61st St., New York February 15. The company will commence radio production in February, and the manufacturing of television sets will begin in the spring. A new division of the company is producing television and FM test equipment including special parts for television sets. These parts and test equipment are now being delivered to other television manufacturers.

Phillips Adds Relays

Phillips Control Corp., 612 No. Michigan Ave., Chicago, Ill., has entered the relay production field. The company has acquired design, manufacturing and sales rights for relays formerly made by G-M Laboratories of the same city. John E. Mossman, co-founder and former vice-president of C. P. Clare & Co., has purchased a controlling interest in the Phillips Control Corp. The company will manufacture all types of relays under the trade name of "Phil-trol".

Philco Developing Auto Radiophones

Among other companies that are investigating and engineering portable mobile radio equipment for the use of automobile owners, Philco Corp., Philadelphia, has let it be known that this company is developing such equipment. Larry E. Gubb told about the equipment briefly but no details have been revealed.

Invention Exposition

World's Invention Exposition is scheduled to open in the Chicago Arena and run from April 11 to 22. It is planned for the exhibit to include all manner of recent inventions including electronic equipment and parts. Dr. Lee De Forest is honorary chairman of the affair which is being put on by World's Invention Exposition, 155 No. Clark St., Chicago. E. K. Green is director of the exhibits.

Bendix Marine Moves

Bendix Marine has moved to Norwood, Mass. The company produces among other marine equipment supersonic depth sounders.

Adds Small Motors

Fractional horsepower motors in standard types of split phase and capacitor start units are to be made by Automatic Control Engineers, Inc., Bedford, Ind. Manufacture of voltage regulators, synchronizers, frequency control equipment and special control apparatus will be continued.

RMA Record Roster

Membership in Radio Manufacturers Association reached an all-time record high of 307 with the election of 35 new members in January. This compares with a low of 104 during the '30-40 period. Among other business transacted at the meeting of the RMA Board in January, plans were made for that body to be enlarged through additional representation for sets, parts and possibly other divisions. A new Amateur Section has been organized with W. J. Halligan as its chairman.

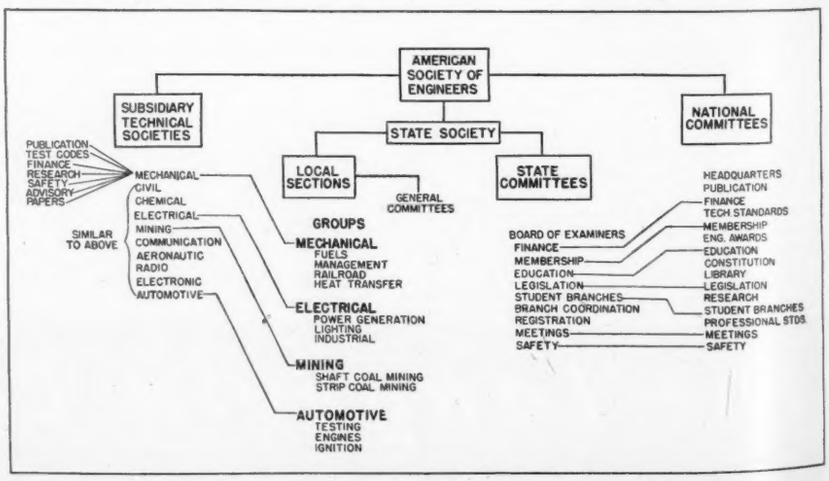
Propose Consolidating All Engineering Bodies

A new method of organizing the engineering profession was proposed at a conference on institute activities at the Winter Convention of American Institute of Electrical Engineers held in New York late in January. Four plans which would consolidate all engineering organizations were considered. One would bring together all electrical engineering societies into a new American Association of Electrical Engineers; another would have the existing engineering societies continue to function in technical matters and include an Engineering Professional Society to carry on non-technical or general activities of interest to engineers. A third proposed the federation of all existing engineering societies to form a Federated Engineering Society which would provide a single control for consideration and action on all technical and professional matters; the fourth plan would set up a new American Society of Engineers into which would be incorporated many of the existing societies. Membership would include all engineers. It was felt by the committee on planning and coordination that the adoption of one or another of these plans would permit the creation of a strong united engineering profession.

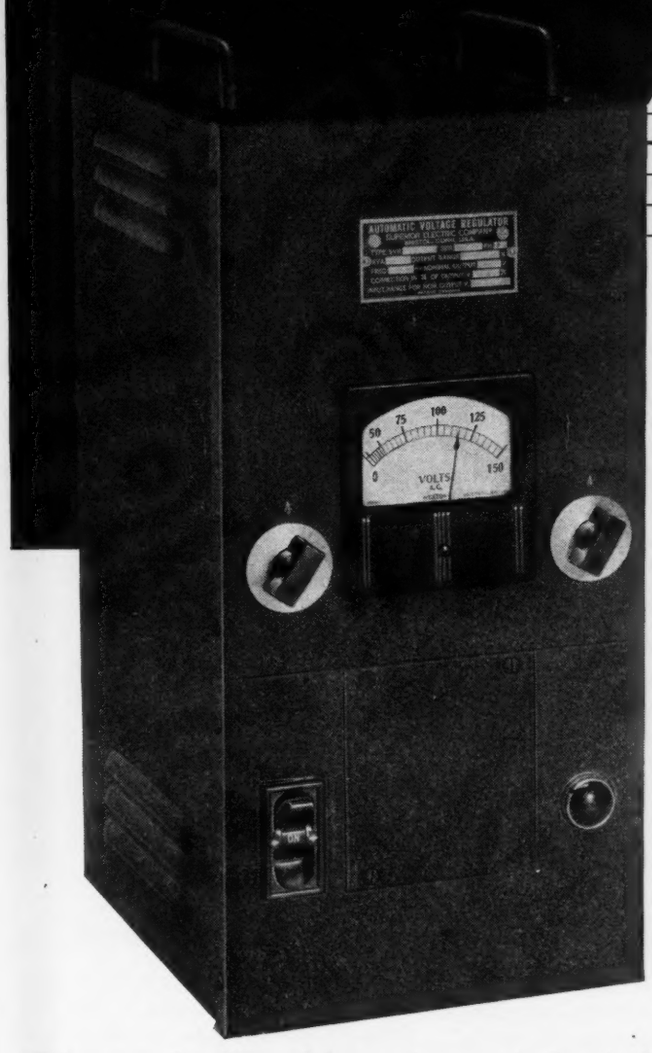
Grants for 278 FM Stations

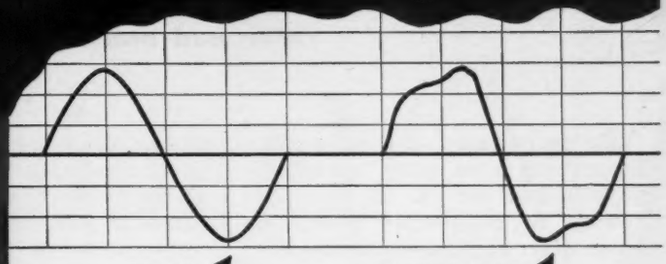
As of the middle of January, Federal Communications Commission had granted 278 conditional licenses for FM broadcasting. Under such procedure companies are permitted to proceed with preliminary plans for obtaining equipment necessary in the establishment of the proposed stations.

Chart showing the manner in which it has been proposed that all engineering groups be organized



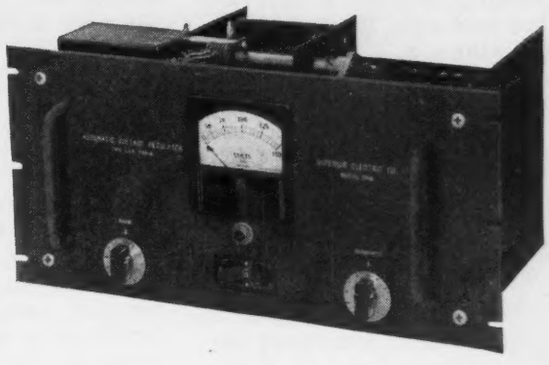
NO WAVE-FORM DISTORTION





WITH

SECO AUTOMATIC VOLTAGE REGULATORS



IN designing electrical apparatus, the engineer not only specifies a definite operating voltage but also assumes that the wave-form of the specified voltage will be a sine wave. If these two factors are not considered, the efficiency and utility of the equipment is drastically reduced if not completely eliminated. Although the SECO automatic voltage regulator can not manufacture a sine wave, it will maintain a constant output voltage without wave-form distortion regardless of variations in input voltage or output load current.

Such desired performance is obtained by combining an electronic detector circuit with a motor-driven variable auto-transformer. There is no dependency on saturation of core material for regulating action. In direct contrast, the variable auto-transformer together with its auxiliary transformer are designed to operate far below the saturation point assuring the zero wave-form characteristic.

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RCA COLOR TV STATUS

Princeton Laboratories demonstration reveals progress in both color and black and white — Tube and transmitter production

Late in January, a third public demonstration of color television, by RCA had for its purpose the showing to prospective television transmitter equipment customers and consulting engineers not only RCA's research in color television, but also improvements in black-and-white television and other recent products of research in the radio field.

About 150 guests gathered at the RCA laboratories in Princeton, N. J., some coming from as far as Texas and the mid-west to witness the demonstrations. E. J. Engstrom, director, made the opening talk during which the group was shown black-and-white television pictures transmitted from the NBC New York station 44 miles away. This transmission was on WNBT's regular assigned channel No. 1, 50-56 mc. The program included a movie short of vaudeville performers, a solo by a photogenic soprano, a ventriloquist who in some ways was better than Bergen and an interpretive dance.

The following television receivers were compared in the order mentioned:

Receiver Comparison

(a) The pre-war model TRK console, selling for $600, direct viewing, 12 in. picture tube showed the picture quality fair, color dirty white, brilliancy normal by pre-war standards. This was compared with RCA's new kinescope improved by a very thin backing of aluminum film applied to the fluorescent material. This does three things: it reflects outward and therefore reinforces the light from the tube; it prevents the heavy ions from producing an undesirable brown spot in the center of the screen; and it permits the application of a considerably higher plate voltage which also produces a brighter picture. All of these taken together have considerably improved the reproduced picture in contrast and in an increase in brilliancy which allows full room illumination without destroying the picture's usefulness.

(b) Two table models were shown, one having a 7 in. tube and one a 10 in. tube. Only the latter was in operating condition. It produced an excellent picture, in fact our reporter preferred it to all the other receivers shown for certain portions of the program. For other portions the projected picture to be described was preferred. These cheaper receivers did not have aluminized screens, but in spite of this fact gave a sufficiently brilliant picture, rated approximately twice as good both in whiteness and light intensity as the pre-war standard.

Projection console

(c) Experimental projection console, a 5 in. picture tube with plate voltage about 28,000 using Schmidt optics produced on a screen illuminated from the rear a picture measuring 16 in. x 21 in. This is the set that RCA has been demonstrating for the last year. The picture brightness is equal to the pre-war direct viewing tube. The detail was satisfactory, but the resolution of the picture did not seem equal to that obtained from a direct viewing receiver. In other words, images were a trifle fuzzier than they were on the directly viewed tube. In comparison with this receiver was shown RCA's latest experimental projection model. This gave the same size picture, but due to increased plate voltage and the aluminum film on the projection tube the light intensity was, say, 40% greater. The color of the picture due to early tube production was marred by yellow streaks. Incidentally, this receiver was the only one that gave difficulty during the demonstration. It went out of synchronization slightly twice during the show. (The 7 in. table model entirely failed to operate at the very start of the demonstration). However, the visitor's impression was that great care had been taken in the arrangement, the scheduling, and the explanations throughout this entire visit to the RCA Labs.

(*Continued on page* 136)

RCA PRODUCTION SCHEDULE FOR EQUIPMENT

TUBES. The Image Orthicon will be in production in the second quarter of 1946. The Orthicon which is still the best for studio work is available at present. Model 1850A is an improvement over 1850 which has been used in the past in that it gives better sensitivity.

An improved iconoscope for amateur use will be available in the second quarter of 1946.

Model A51, 5-kw transmitter tube, available third quarter of 1946.

RECEIVING TUBES. For direct viewing there will be the 7 in. tube model 7GP4, 3000 v plate, a low priced tube.

Model 7DP4 will have an ion trap and be of superior quality.

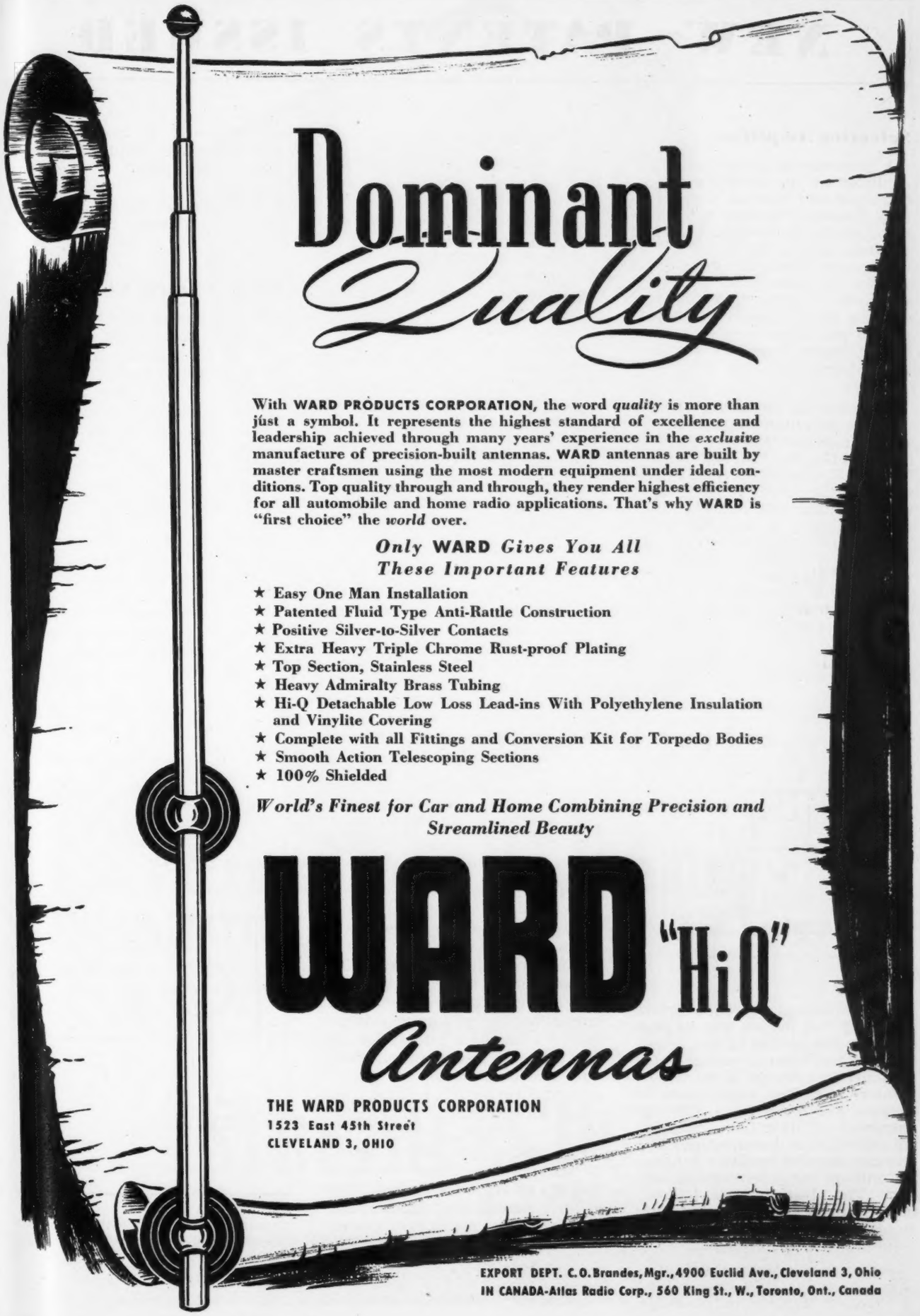
The 10 in. model 10BP4, 8000 v plate, with ion trap will be used in consoles of good quality.

A 5 in. view finder tube model 5 FP4A is planned and a 7 in. portable monitor tube 7CP4.

All of these will be available in the second quarter of 1946.

OTHER TUBES. A 15 in. direct view monitor tube and a 5 in. model 5TP4 projection tube, 30,000 v plate for use with Schmidt optics will be announced in 60 days. It will be treated with the aluminum film, but the direct view tubes will not have this because of cost and because the brightness is acceptable as is.

TRANSMITTING EQUIPMENT. RCA plans to produce portable Image Orthicon cameras for remote pickup. These together with their portable control equipment will be produced first to give customers a chance to experiment both indoors and outdoors with television while transmitters are being built. This equipment will be ready in the early summer of 1946. Next, motion picture scanners will be produced. Television transmitting equipment will follow and this should be ready for delivery in the early fall. Orders will be filled in the order of their receipt. Prices will be available in a few weeks.



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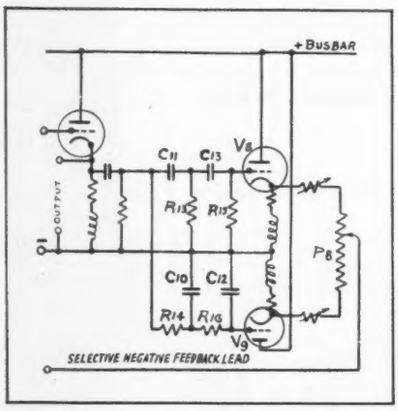
NEW PATENTS ISSUED

Selective Amplifier

A frequency-selective amplifier or oscillator of the feedback type is described and claimed which permits frequency control by adjustment of one potentiometer in the feedback circuit. An approximately logarithmic frequency dependence on the potentiometer setting is achieved. Frequency selectivity is effected by the negative feedback path which feeds back no voltage at the desired frequency and provides degeneration at other frequencies.

According to the present invention the ac output voltage of the amplifier or oscillator is fed to two networks C_{11}, R_{13}, C_{13}, R_{15}, and C_{10}, R_{14}, C_{12}, R_{16}, respectively. It will be seen that the output voltage amplitudes of these two networks vary with frequency in opposite directions while always being 180° out of phase; any other suitable network supplying such voltages may replace this particular arrangement. The feedback voltage is taken between the negative terminal and

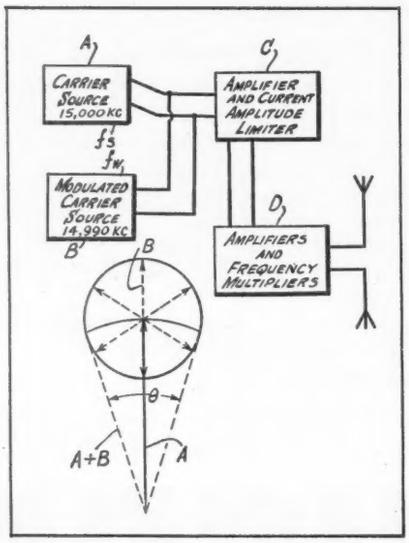


the potentiometer P_8. For a certain frequency the output will be zero at the center setting of the potentiometer but have a certain value for other frequencies. If the potentiometer is shifted, cancellation of voltages will occur for a different frequency, all other frequencies being subjected to degeneration. This provides selective feedback depending only on the potentiometer setting. The two cathode-follower tubes serve as impedance matching devices. Several variations of the basic principle are considered.

B. M. Hadfield, Automatic Electric Laboratories Inc., (F) June 5, 1942, (I) October 16, 1945, No. 2,386,892.

Diversity System

The unmodulated carrier from A has a strength considerably greater than the other carrier from B; a 2:1 ratio is satisfactory in many cases. Then the output of C will constitute a phase modulated wave having a carrier of frequency f_s and two principal side bands spaced from this carrier f_s by the frequency difference $f_s—f_w$. A frequency difference of 10,000 to 20,000 cycles is sufficient to reduce greatly the probability of both waves fading out simultaneously to a degree at which distortion results. It is proposed to use these two side bands as the two waves of a diversity system.



To explain the phase-modulating effect, consider the vector diagram at the lower left of the figure. The weaker current B is added vectorially to the stronger current A at angles varying uniformly with respect to time at a rate of 360 deg. per cycle of beat between them. The resultant vector A plus B therefore varies in amplitude and phase with respect to the stronger initial current A; amplitude and phase modulation will be present in the output. Phase variations through an angle θ will occur. Upon passage through an amplitude limiter, a phase modulated current will be passed onto the subsequent amplifiers and frequency multipliers.

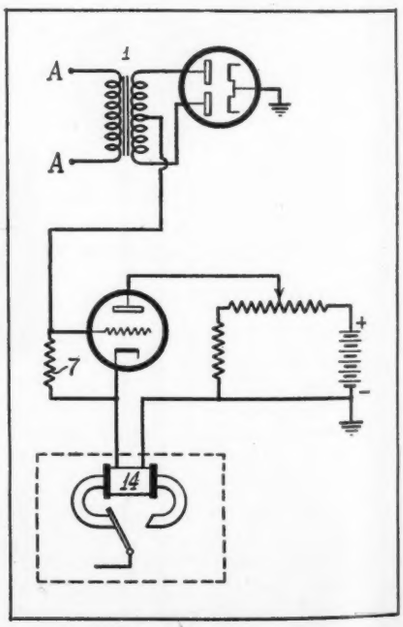
In the receiver, the two sidebands are separated by frequency selective channels, amplified, demodulated and applied to a diversity system.

C. W. Hansell, RCA, (F) June 26, 1942, (I) October 30, 1945, No. 2,388,053.

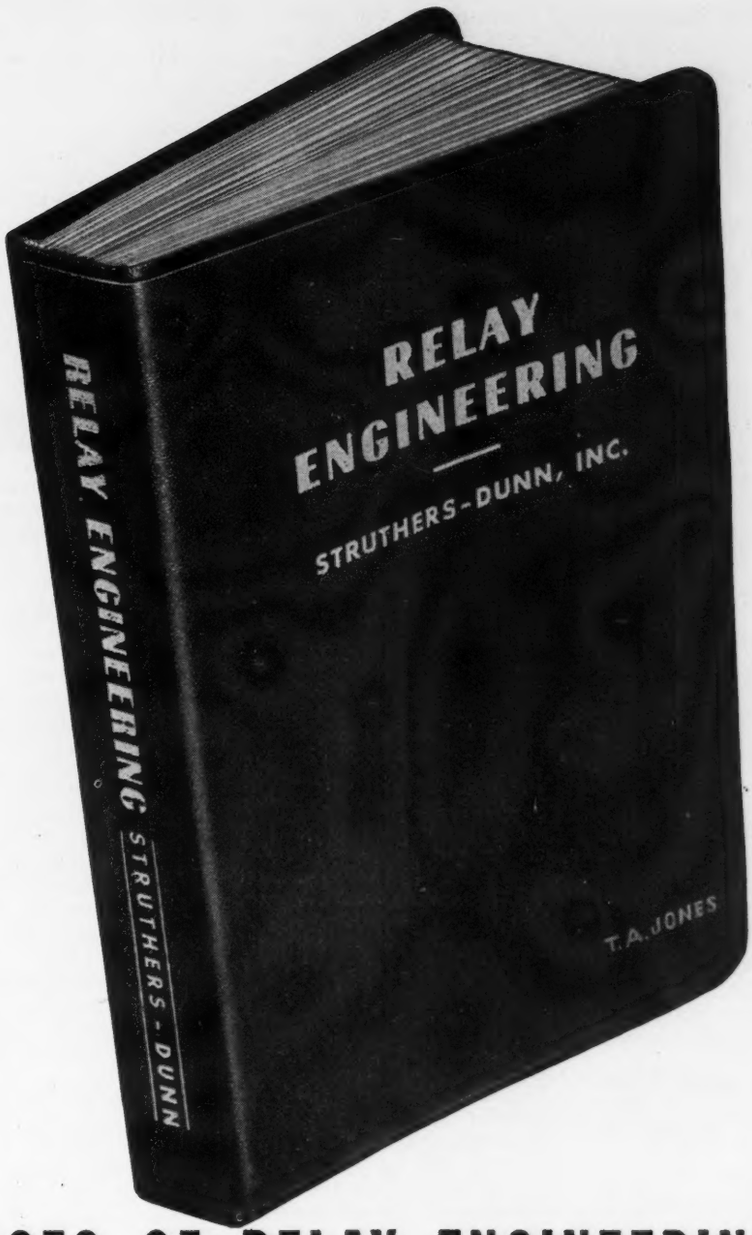
Relay Control Circuit

It is intended to reverse the direction of the current in the relay coil 14 in response to a keying signal which is applied to the terminals A,A; the input signal may convey a telegraph message.

The negative voltage generated at the center tap of the input transformer 1 upon reception of a signal is applied to the grid of the triode, preventing it from carrying current. Further this negative voltage causes a current to flow through resistor 7 and the winding of relay 14 to the ground. At no-signal condition, there will be no current through resistor 7; the grid will be at ground potential and the tube will become conductive. The current now flowing through the relay 14, which is included in the tube circuit, is of opposite polarity to the current previously flowing,



causing a reversal of the armature position. Resistor 7 may be assigned a value to make the two currents alternately traversing the relay winding of equal intensity.



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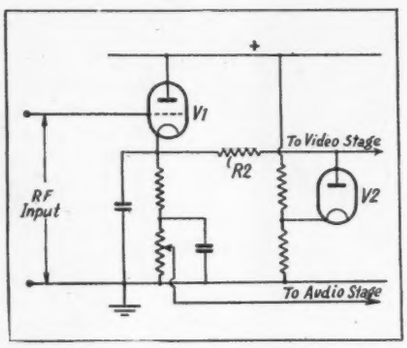
In an alternative arrangement, the rectifier tube and the input transformer are omitted, the center of the battery is grounded and a telegraph key is provided in a lead connecting the negative side of the battery with the grid of the tube.

W. E. Simpson, RCA, (F) September 28, 1942, (I) October 23, 1945, No. 2,387,536.

Limiter Circuit

In connection with panoramic radio receivers it is desired to provide a detector arrangement where one of several outputs, the video output, is limited, while another output, the audio output, is not limited. For this purpose, the cathode of the cathode-follower

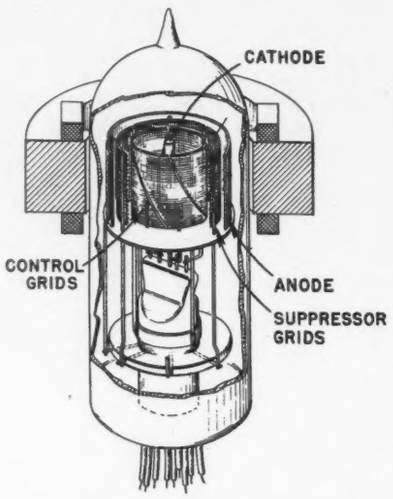


detector tube V_1 is connected to a limiter diode V_2 through a resistor R_2 which has a high resistance compared with the diode impedance.

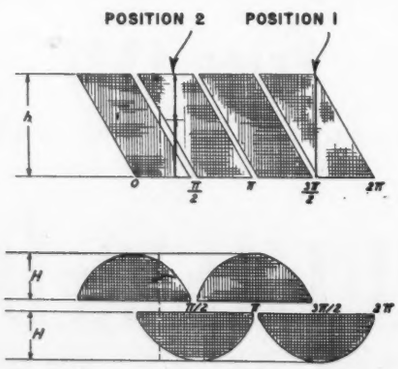
G. J. Scoles, Metropolitan-Vickers Electrical Co. Limited, (F) September 21, 1943, (I) August 21, 1945, No. 2,383,420.

Phase Shifter

The elongated cathode of the tube illustrated is surrounded by arcuate control grids and, further out, by suppressor grids, and finally by the anode which is at a positive potential with respect to the cathode. A continuously and uniformly rotating magnetic field with the lines of force normal to the axis of the cathode is generated between four poles of a magnet, the coils of which are appropriately fed by the currents from a two-phase alternator. The rotating magnetic field in combination with the radial electrostatic field between cathode and anode forces the electrons to move in a sheet extending in a radial direction between the cathode and the anode. This electron sheet will rotate so as always to follow the direction of the instantaneous maximum of the rotating magnetic field. Suppressor grids are mounted to suppress the electron sheet which would otherwise be projected in the opposite direction as seen from the cathode. This operation of the suppressor grids will obtain if the two diametrically opposite suppressor grids are connected in opposite polarity to the first phase of the alternator and the remaining two suppressor grids to the second phase; an electric field rotating synchronously with the magnetic field will be set up in the space between the suppressor grids.



An exploded view of the control grids is also shown; in the tube they are arranged in a cylinder concentric with the cathode. A phase splitting circuit supplies four equal 90 deg. out-of-phase voltages which are applied to the four sections of the control grid, respectively. In operation, if the sheet-shaped electron beam is so positioned that it passes only one of the control grid (position I on the drawing) the phase of the plate current will be identical with that of the voltage on this grid section. However, if part of the beam passes through one grid section and another part through another grid section (position II), the phase of the resulting anode current will be



determined by the proportion of the beam that traverses the respective grid sections. By this expedient it is possible to shift the phase of the resulting current.

It can be proved that if the control grids have sine shaped contours as shown in the second view, the resulting current will be of the form: $i=i_0 \cos 2\pi (f_1 t + x)$, where $x = f_2 t$, f_1 being the frequency of the control grid voltage and f_2 the frequency of the alternator voltage. It will be seen that for this shape of control grids, a phase shift proportional to time and equivalent to a linear frequency shift is achieved.

K. G. Jansky, Bell Telephone Laboratories, (F) November 15, 1943, (I) December 11, 1945, No. 2,390,884.

Synchronizing Rotating Beam Tube

The patent describes and claims a system to synchronize the rotation of a receiving multi-anode rotating beam tube with the transmitting rotating beam tube. In this multi-anode tube the several anodes are arranged on a cylindrical surface surrounding a cylindrical cathode and a radial rotating electron beam impinges upon these anodes in succession. Grids are provided which cut off the electron beam so that a modulated output may be achieved. Details of the tube can be found in an article by A. M. Skellett in the Bell System Technical Journal, April, 1944, summarized in the July, 1944, issue of ELECTRONIC INDUSTRIES on page 222.

The invention is concerned with an apparatus to synchronize the rotating magnetic field of the receiving tube with that of the transmitting tube. It is the purpose of the rotating magnetic field to control the rotation of the electron beam and, therefore, it is desirable that these fields be synchronized to ascertain that if the beam impinges upon a certain anode of the transmitting tube, it impinges upon a corresponding anode in the receiving tube. To obtain this feature, the output of two anodes are made to control the rotating magnetic field, initial adjustment being made by having the electron beam directed towards a preselected anode if no signal is received.

A. M. Skellett, Bell Telephone Laboratories, (F) July 17, 1942, (I) October 16, 1945, No. 2,387,045.

Makes Cord Sets

Haft & Sons, Inc., has been organized with headquarters at 79 Third Street, Brooklyn, N. Y., for the manufacture of cord sets and electrical wiring devices. Lester Haft was formerly, and for the past 30 years, treasurer and general manager of the C. D. Wood Electric Co. He is joined by his two sons, Alexander and Marshall.

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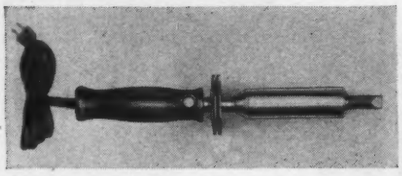
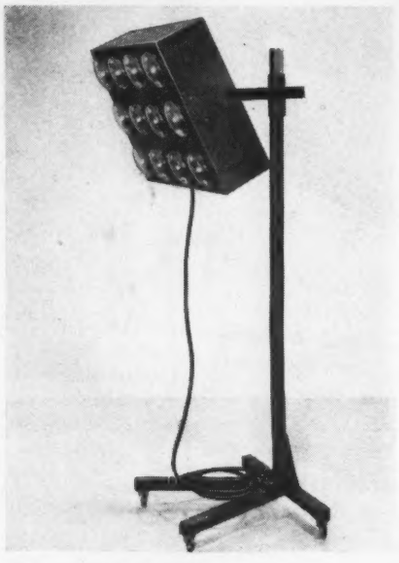
WHAT'S NEW

Devices, products and materials the manufacturers offer



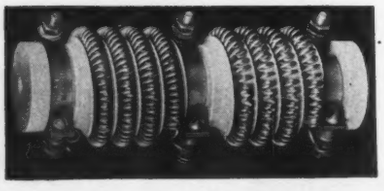
Soldering Iron

A new dual-heat electric soldering iron is manufactured by the Dual-Heat Iron Co., 4370 Sunset Blvd., Los Angeles 27, Calif. The iron provides two heats and is suitable for aluminum soldering, tinsmithing and production soldering. The high temperature reserve heat is available by pressing a button in the handle. The heating element is molded into a ceramic insulator.—Electronic Industries



Infra-Red Equipment

Heat required for various industrial applications such as drying, baking, dehydration and evaporation is supplied by portable electric infra-red equipment being made by the Carbomatic Corp., Dept. P 146, 117 West 63rd Stret, New York 23. The new R-12 model accomodates 12 lamps, either 125 watt or 250 watt size, and is equipped with three toggle switches, permitting operation of 1, 2 or 3 rows of four lamps each. —Electronic Industries



Center-Tap Resistor

A new type CAM center-tap resistor has been developed by the Regan Engineering Corp. and is marketed by Techtmann Industries, Inc., 828 Broadway, Milwaukee 2, Wis. The resistor consists of a core of solid steatite, uopn which is wound a helical resistance wire element. If a unit overloads or burns out, the coil can be replaced by removing two nuts without disturbing connections or supporting assembly.—Electronic Industries

Street Lighting Control

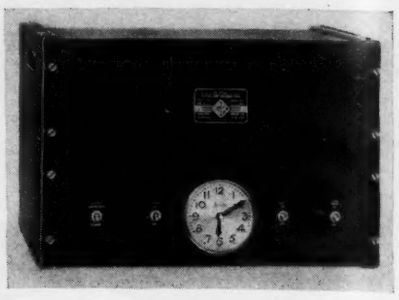
A new automatic unit for turning street lights, exterior lighting of public buildings and outdoor advertising signs has been designed by Ripley Co., Torrington, Conn. This electronic "Sun Switch" consists of a photoelectric cell, standard amplifier tubes and a relay. Under normal conditions light is provided from 25 minutes after sunset to 25 minutes before sunrise. The unit is inexpensive enough that individual installations on each light pole can be made.—Electronic Industries

Communications Receiver

Hammarlund Mfg. Co., 460 W. 34th St., New York, has developed the Series 400 Super-Pro communication receivers. Two models are available, the SP-400-X with a tuning range of .54 to 30 mc in 5 bands, and the SP-400-SX, tuning from 1.25 to 40 mc in 5 bands. Continuous bandspread is available for three hf bands. Six-position crystal filter, AVC over four stages and low impedance antenna input for balanced transmission are provided.—Electronic Industries

Switch

A 50 ohm switch designed by Bird Electronic Corp., 1800 E 38th St., Cleveland 14, Ohio, is made for selector use in coaxial circuits below 4000mc. To provide for switching of antennas, receivers, low power transmitters and other intra-equipment functions these units maintain good impedance characteristics and low standing wave ratios are realized.—Electronic Industries



Precision Fork

A vacuum-tube precision fork for standardization at low frequencies is being produced by the General Radio Co., Cambridge 39, Mass. The type 816 tuning fork has a frequency stability of 0.001% and a maximum output of 2 watts is supplied with either sinusoidal or peaked waveform. The fork is housed in a temperature-controlled chamber and drives a synchronous clock. It is available in two models, type 816-A with a 50-cycle fork and type 816-B with a fork frequency of 60-cycles.—Electronic Industries

Iconoscope Yoke

Iconoscope yokes built to exacting specifications are being manufactured by the United States Television Mfg. Corp., 106 Seventh Avenue, New York. The yoke has a vertical inductance of 2 millihenrys and a horizontal inductance of 100 microhenrys, both measured at 1000 cycles. The crosstalk ratio in voltage is 1000 to 1, measured from horizontal to vertical coils. An improved horizontal output transformer also is available for the yoke.—Electronic Industries

Colored Flanges

The Marion Electrical Instrument Co., Manchester, N. H., has a new line of round or square interchangeable colored flanges for 2½ in. and 3½ in. hermetically sealed electrical indicating instruments. The flanges are available in 12 different iridescent colors. —Electronic Industries

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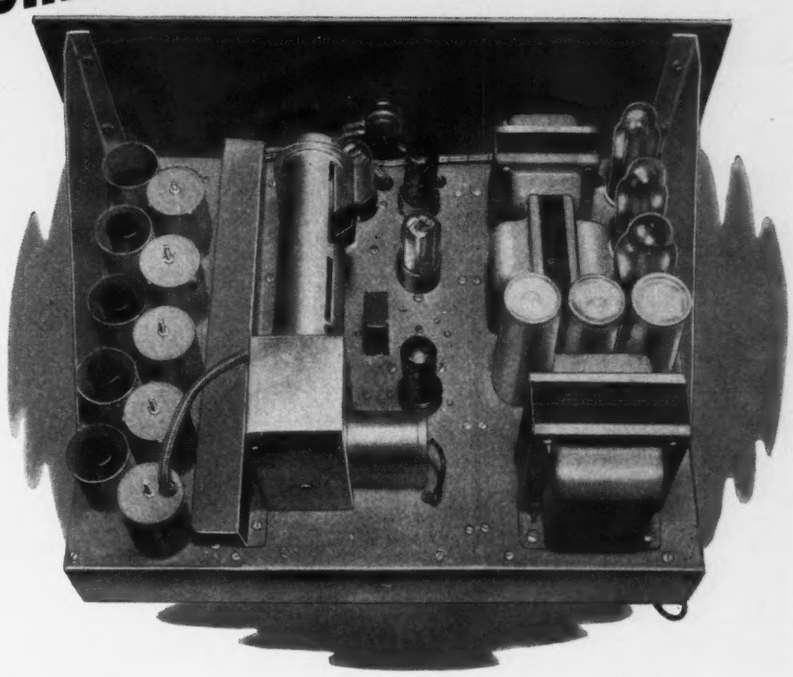

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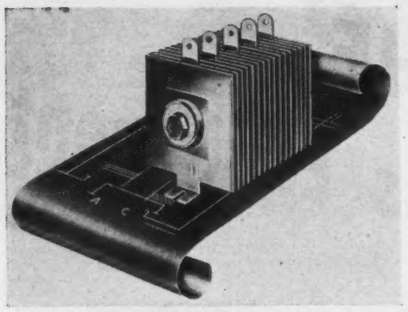
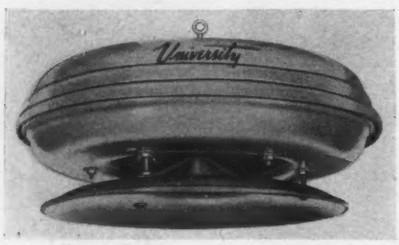


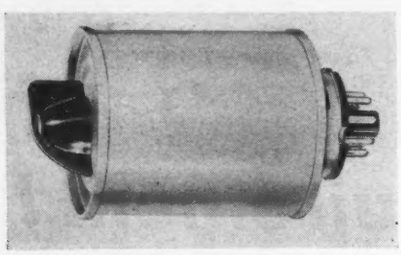
Copper Sulphide Rectifier

Benwood-Linze Co., St. Louis, Mo., has developed a copper sulphide rectifier unit which will carry 50a without forced air cooling. This unit was designed for 6-volt storage battery taper charging.—Electronic Industries



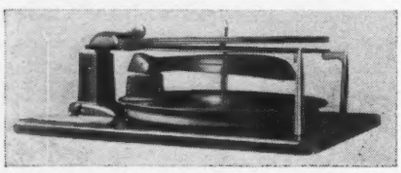
Sound Projector

Infinite baffle housings for 8 and 12 in. cone speakers are being made by University Laboratories, 225 Varick St., New York 14, N. Y. They will provide complete 360 degree sound diffusion without undue concentration under the speaker unit. The 12 in. model will handle frequencies down to 50 c.p.s.—Elecrtonic Industries



Self Timing Interrupter

A unit with either a fixed predetermined rate or an external adjustable rate of interruption is being built by Electronic Controls, Inc., 44 Summer Ave., Newark 4, N. J., for service in warning and blinking signals, industrial controls and process timing. Timing range is from 1 to 12 pulses a second. Control contacts are either SPST or DPST. —Electronic Industries

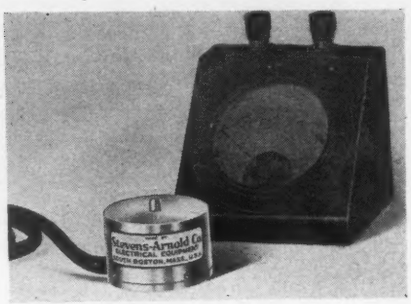


Record Changer

Chipping and the enlarging of the center hole in records is minimized in the Velvet Action record changer being made by Farnsworth Television and Radio Corp., Fort Wayne, Ind., by the use of three record shelves in place of the usual one or two. The unit uses a rim driven turntable. Any standard pickup cartridges can be fitted in the pickup arm.—Electronic Industries

Wheatstone Bridge

A portable Wheatstone bridge unit for Murray, Varley, Hilborn, and Fisher loop testing and straight resistance measurements is being made by Winslow Co., 9 Liberty St., Newark 5, N. J. Resistances in excess of 100,000 ohms are measured with an external battery Galvanometer is a replacable unit.—Electronic Industries



Pressure Pick-Up

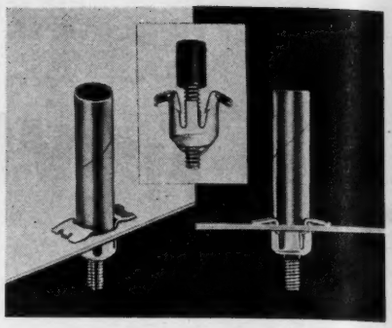
A pressure and deflection pick-up, which translates minute deflections or pressure variations into linear changes in its dc output voltage, has been designed by the Stevens-Arnold Co., 22 Elkins Street, South Boston, Mass. The pick-up may be connected directly to standard indicating instruments and accurate readings are obtained in the range of 0.0005 in. to 0.1 in. movement of the plunger up to 100 cps.—Electronic Industries

Multimeter

A new combination volt-ohm-milliammeter is now in production by Triplett Electrical Instrument Co., Bluffton, Ohio. Using 40 microampere as full range meter deflection, the unit has exceptional sensitivity; dc voltage ranges use resistance values of 25,000 ohms per v. Long 5½ in. scale provides easy meter readings.—Electronic Industries

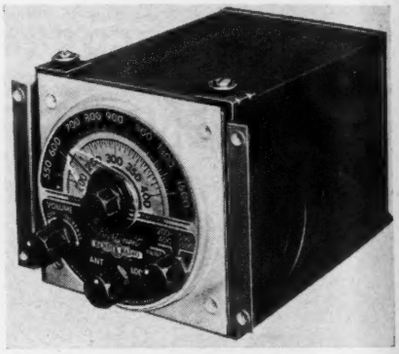
Contacts

A new series of silver tungsten and silver tungsten carbide contacts is being made by Gibson Electric Co., 8362 Frankstown Ave., Pittsburgh 21, Pa. These new contacts have high current carrying capacity, greater non-welding characteristics and longer life. In an air circuit breaker a contact with less than 1/6 sq. in. contact area will repeatedly break 15,000a at 600v without excessive wear, sticking or welding.—Electronic Industries



Coil Tube Mounting

A new Speed Nut fastener which will securely mount coil tubing to the radio chassis and also provide an accurate vibration-proof adjustment for the iron tunnig core, is being made by Tinnerman Products, Inc., 2111 Fulton Road, Cleveland 13, Ohio. These fasteners are available for 9/32 and ⅜ in. O.D. tubings.—Electronic Industries



Aircraft Receiver

Bendix Radio, Baltimore 4, Md., is making a personal aircraft receiver that weighs under 5 lbs. Two tuning bands are provided. Reception on the 200-400 kc band allows pickup of airport control towers, civil airway stations and range stations. Regular broadcast programs can be used on the other band for navigation or entertainment With a loop the receiver will allow aural null homing guidance.—Electronic Industries

Signalling Timer

The Series S signalling timer has been redesigned to give both visual and audible alarm at the completion of a time interval. Elapsed is shown on the dial. Models of the timer can be had for 115 to 230 volts ac, 25, 50, or 60 cycles. It is made by the Industrial Timer Corp., 117 Edison Place, Newark 5, N. J.—Electronic Industries

Wave Makers

"A leaping trout awakens the still pool to life in waves that move in silent rhythm."

In the same way, when you speak over the telephone, vibrating electric currents speed silently away with the imprint of your voice over the wire and radio highways of the Bell System.

Tomorrow, the vibrations will be the living pictures of television. All are examples of wave motion.

How to produce, transmit and receive electrical wave motion is the basic problem of the communication art.

Bell Telephone Laboratories, which exist primarily to invent and develop better communications for the Bell System, devote the teamed efforts of physicists and mathematicians to the production and control of electric waves in all forms.

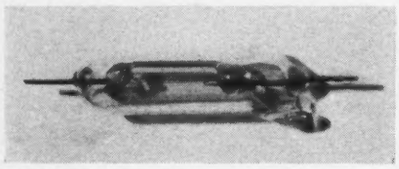
Out of these fundamental studies have come the discoveries which keep the Bell System at the forefront of the communication art.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR THE CONTINUED IMPROVEMENT OF TELEPHONE SERVICE

Cathode-Ray Tube

Allen B. Du Mont Labs., Inc., of Passaic, N. J., has developed a cathode-ray tube providing an image of high luminosity for television receivers. The type 7EP4 is a 7 in. tube with a normal screen image of 5¾ in. wide by 4¼ in. high and requires an operating potential of 2500 volts allowing the use of a low-cost power supply.—Electronic Industries



Bolometer

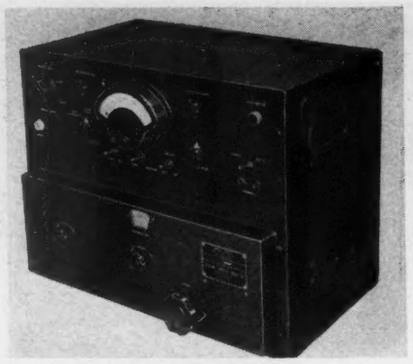
A new vacuum type bolometer for use in UHF bridge circuit measuring equipment is being manufactured by Lynn Engineering Co., 912 Westfield Ave., Elizabeth 3, N. J. Sensitivity is about 1% change of resistance for each 4.5 microwatt variation in power. Smallest unit shows 200 ohms at 0.5 ma.—Electronic Industries

Range Callibrator

For use in calibrating the sweep speed of a synchroscope or triggered sweep oscilloscope in commercial radar and television test work, United Cinephone Corp., Torrington, Conn., is making a new B sweep calibrator model 8127. Switch permits selection of four different time intervals. Markers have choice of polarity. Trigger pulses also with a choice of polarity have repetition rate variable from 2000 to 3000 cps. Gate duration is 20 to 3000 microseconds.—Electronic Industries

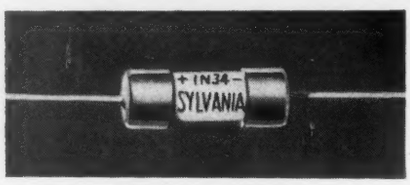
Switch

A new Micro switch featuring "make before break" contacts has been introduced by First Industrial Corp., Freeport, Ill. This action is obtained by the use of two spring members. The new switch is mounted in the standard size bakelite case and is, when necessary, interchangeable with the regular types.—Electronic Industries



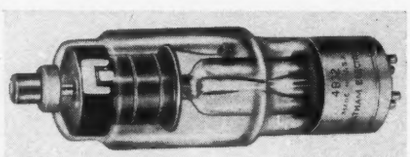
Field Intensity Meter

Now ready for civilian distribution is a new noise and field intensity meter designed to locate sources of radio interference. The model NMA-4 is produced by the Stoddart Aircraft Radio Co., 6644 Santa Monica Blvd., Hollywood 38, Calif. It locates and indicates in microvolts the amplitude of noise causing disturbance to radio reception in aircraft, landcraft, seacraft, etc. Frequency range 100-400 mc, voltage range 1 to 100,000 microvolts, field intensity range 5 to 100,000 microvolts per meter.—Electronic Industries



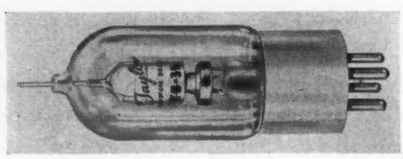
Compact Crystal Diodes

Germanium crystal diodes suitable for use as detectors, frequency discriminators, low frequency oscillators and such kindred applications have been developed by Electronics Div., Sylvania Electric Products, Inc., Boston, Mass. These units are about the size of a small resistor and may be wired directly into various circuits. No heater supply is required. Average anode current is 22 ma.—Electronic Industries



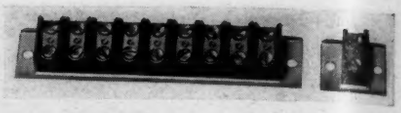
Xenon Rectifier

With only a 10 v drop, an Xenon filled rectifier tube is in production by Chatham Electronics, 475 Washington St., Newark 2, N. J. Tube will carry an average anode current of 1.25 a at an inverse voltage peak of 10,000 v. Filament operates at 5 v ac at 7.5 a.—Electronic Industries



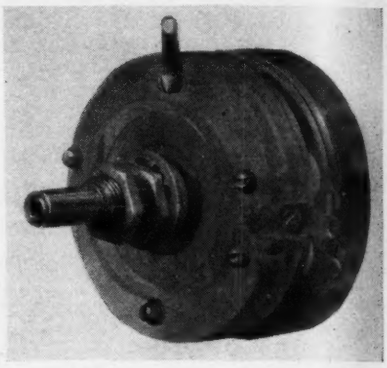
Beam Tetrode

A new uhf beam tetrode, the Taylor TB-35, has been added to the line of Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago, Ill. The tube operates with full power input up to 250 mc and at half-power input to 400 mc and provides a power output of over 125 watts in class C telegraphy applications. The plate connection is brought at the top of the envelope and the tube is mounted on a four-pin ceramic base.—Electronic Industries



Terminal Block

A space saving assembly with the flexibility of one to twenty-four individual terminals has been designed by Curtis Development & Mfg. Co., 1 N. Pulaski Rd., Chicago 24, Ill. In addition to quantity orders of a single type, kits are available containing individual terminals and various length mounting channels which can be used on special and experimental equipment.—Electronic Industries

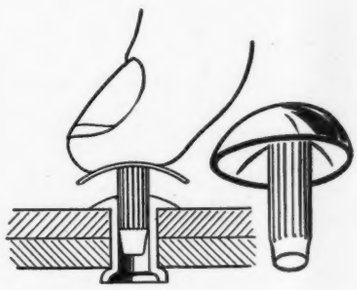


Ring Tuner

The Caltron Co., Los Angeles 34, Calif., has developed a new 145 mc ring tuner, which consists of a complete variable tuning unit in a compact assembly for single hole mounting. The unit has a tuning range of 140 to 160 mc with 3.5 mmf tube capacity and a rotation of 180 degrees. A stationary ring comprising a 2-turn inductance and a rotary ring of 1 turn together form the plates of a variable condenser, thus making up the tuning unit.—Electronic Industries

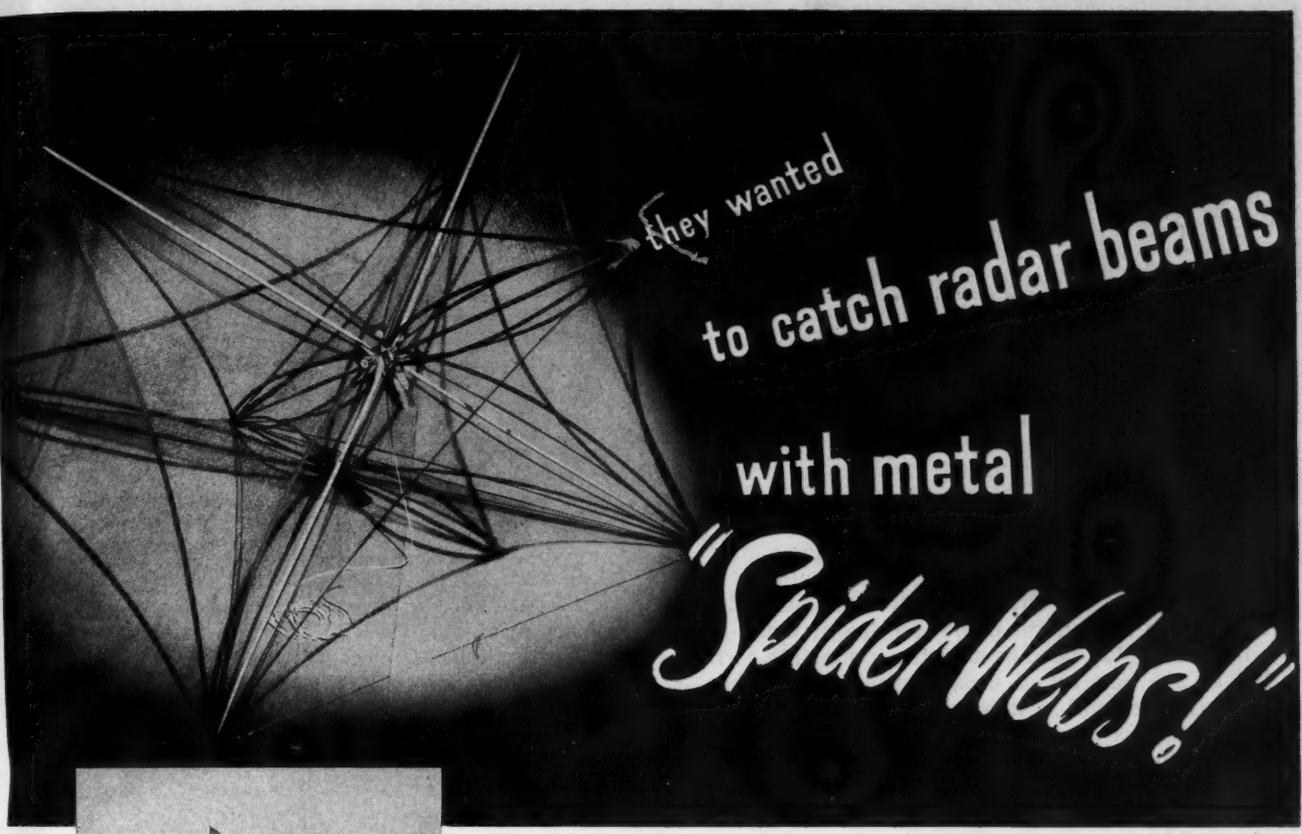
Dial Light

A small tubular lamp is being made by Westinghouse Electric Corp., Bloomfield, N. J., for the illumination of radio panels and phonograph compartments. These lamps are also made with black light phosphors coating so that while no visible light is generated, specially treated control knobs and dials will fluoresce with easy visibility.—Electronic Industries



Umbrella Plug

The umbrella plug matches or harmonizes with the surface color or texture of the material being fastened. The plug fits into the center of the hollow type Cherry rivets and furnishes a smooth cap completely covering the head of the rivet. These plugs are available in aluminum, copper or plastic. Made by the Cherry Rivet Co., 231 Winston Street, Los Angeles 13, Calif.—Electronic Industries



The reflector in use...and as it is packed

Eleven different "spider webs" of Monel mesh in the Vendo reflector catch radar beams approaching from any quarter. The mesh, knit from 0.0035-inch Monel wire, is furnished by Metal Textile Corp., Orange, N. J.

One of the problems was to make the reflector compact enough to fit in the smallest life raft pack. By using easily-folded Monel mesh, the unit can be stowed in a waxed cardboard carton, only 25" long and 1¾" square.

Peacetime possibilities include use as an aerial for home radios. One report cites tremendously improved reception.

In 1942, Eddie Rickenbacker and his companions crash-landed in the Pacific. For 22 days, airplanes combed the sky before sighting them.

Three years later, airmen forced down at sea were being found in a matter of hours . . . on blackest nights . . . in roughest weather.

. . . for radar was being used to locate friend as well as foe!

A metal reflector, developed by the National Defense Research Committee, turned the trick.

Known as the "Corner Reflector," it enabled life rafts to be easily detected by radar-equipped rescue craft.

To make the reflector, 4 ounces of wire mesh are formed into 11 triangular webs and stretched out on a collapsible framework. It is this mesh which reflects the radar waves and sends them back to appear as spots on the radar scopes of searching airplanes or ships.

Working with the Army and Navy, Vendo Company of Kansas City tested many metals for the mesh.

The metal had to offer just the right electrical and electronic characteristics. The metal had to be strong, so that the delicate mesh would not be ripped apart by winds. And *(of greatest importance)*, it had to resist corrosion by salt spray. For the slightest corrosion would set up high resistance at the thousands of mesh contacts, and seriously cut down over-all conductivity.

Of all the materials tested, only one was found to possess all the properties needed.

That was knit Monel mesh.

Remember Monel and other INCO Nickel Alloys whenever you need a "hard-to-find" combination of properties for electrical or electronic applications. For more information on metals that fight . . . corrosion . . . wear . . . fatigue . . . heat . . . stress . . . write for "Tremendous Trifles."

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WASHINGTON

★ ★ ★ Latest Electronic News Developments Summarized by *Electronic Industries'* Washington Bureau ★ ★ ★

GOVERNMENT WATCHING ELECTRONIC DEVELOPMENTS—Official government leaders in Washington from President Truman down, now are coming to full realization that the radio-radar-electronics industry holds the promise of very great potentialities—possibly the industry with the greatest prospects—in the Nation's future prosperity. The new developments, which are daily being unfolded, as the cloak of military secrecy is lifted, with their promise of public acceptance and value, have impressed topmost government officialdom tremendously. Television with immediate public service of black-and-white and color video around the immediate corner; FM as the new sound broadcasting service and its huge numbers of stations planned; radar with almost limitless possibilities in air and sea and land navigation control and safety; the new many-sided radiocommunications uses in railroads, marine and highway mobile fields; and electronic industrial requirements (exemplified in one small illustration in the Army's huge electronic computer and calculator)—these are the new wonders attracting most intense governmental interest.

PRICE DETERMINATIONS—Just as in business and industry, because of the labor and price situations, the reconversion period in government activities has been one of confusion and seeming rudderless course, particularly with regard to price determinations and labor disputes. The government agencies having to deal with affairs related to radio and electronics can greatly aid the reconversion progress. Chief governmental cog is the FCC, but the Commission has found its load of work in regard to the new radio art developments, particularly television and FM, too much for its present staff. Fortunately FCC is getting some relief in additional technical employes with an increased appropriation of $585,000. Government aid is further exemplified in the Bureau of Standards with its ionosphere and propagation studies under its well known radio chief, Dr. J. H. Dellinger.

FCC CHANGES—Shift of Commission Chairman Porter to the helm of the OPA meant another upward rung for that able official to participation in government's cabinet deliberations, but was a loss to FCC. For the radio manufacturing industry, however, it was important because a man, knowing its problems, was heading the price control agency. Youthful Commissioner Charles R. Denny Jr., exceptionally able, was (at this writing) projected as Porter's successor as FCC chieftain. This will mean a greater ascendancy for the Commission's Law Department, because Denny was FCC General Counsel before being elevated. On the engineering side of the FCC's functioning, Commissioner E. K. Jett, the most respected technical government official in radio, will keep the reins on all engineering and allocations problems.

NO 2-BAND FM RECEIVERS—FCC, in rejecting the proposal for two bands for FM broadcasting, has now finally determined troublesome allocations matters, and manufacturers have been able to make final design and production planning as a result of this decision on the basis of the single-band "upstairs" assignment for this service. The Commission felt that the high-band coverage by FM in urban communities and surrounding area will be better than present Standard broadcasting service throughout the entire Eastern area of the nation and a very large portion of the West. Before the war there were only 300,000 to 400,000 sets capable of FM reception and almost all were combination AM-FM, so the listening public will not be hurt. The conference method of FCC, instead of staging hearings, to determine service areas of FM station applicants to determine metropolitan and rural coverage, will expedite authorizations of construction permits.

PRIVATE AIRPLANES TO HAVE VHF SOON—Prediction of CAA Administrator Wright of VHF becoming standard for private fliers in next few years—with 500,000 private planes to be flying in next decade—presents interesting outlook for radio manufacturing industry. Even though switch may be gradual, the CAA Administrator sees future for radio manufacturers. To cut down expense for private fliers who want minimum apparatus, portable 5-channel sets can be installed in planes with addition of new crystals in existing transmitters and receivers.

ANSWER TO UNIONS' CHARGE OF MANUFACTURING "SIT-DOWN"—Civilian Production Administrator Small has refuted labor union accusations of excessive inventories held by radio manufacturers of sets. Out of fifteen major radio manufacturers surveyed up to the end of 1945, three had not got into production because of difficulties in obtaining components and the twelve producing companies had made 160,155 sets in the last quarter of 1945 and only had an inventory of 18,299.

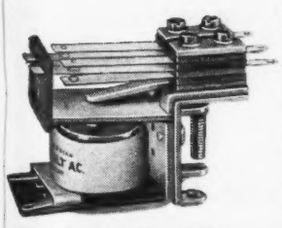
MISCELLANY—Broadcasting "Facsimile", with the goal of newspapers being produced in the home receivers, considered the "sleeper" of the new radio services, is to be launched in Washington by Cowles Broadcasting interests with plan pushed by former FCC Commissioner "Tam" Graven, now Cowles executive vice president . . . Discoveries of German electronic developments, uncovered by Army Technical Industrial Intelligence Board investigators (just shifted to Commerce Department), worth watching by American industry; paper capacitors and selenium rectifier processes may be particularly helpful. Address Publications Board TIIB, Commerce Department.

National Press Building
Washington, D. C.

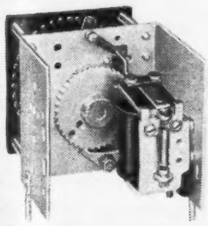
ROLAND C. DAVIES
Washington Editor

PERFORMANCE • PRICE • DELIVERY

RELAYS
BY GUARDIAN



Series 100 A. C. Relay



Series R Stepping Relay

More and more of today's instruments, appliances and machines start, stop, see, hear, measure, count, time, record, talk, fly, with Relays by Guardian. Manufacturers who designed these products thought they needed "specials", yet found Guardian *standard* Relays better qualified on performance—price—delivery. For example, the Guardian Series 100 Relay is a standard type with replaceable coil and contact combinations available. Has a wide operating range from 3 v. to 230 v. at 60 cycles. Another unit, the Series R Stepping Relay is built for three basic types of A.C. and D.C. operation: 1. Continuous rotation; 2. Electrical reset; 3. Add and subtract. These and other Guardian controls and Guardian's speed and flexibility of manufacturing can make things easier for you. Send for NEW RELAY CATALOG showing 43 basic types of relays, a complete line of solenoids, magnetic contactors, switch parts, together with operating data, specifications, suggested applications. Your catalog is waiting. No cost. Write.

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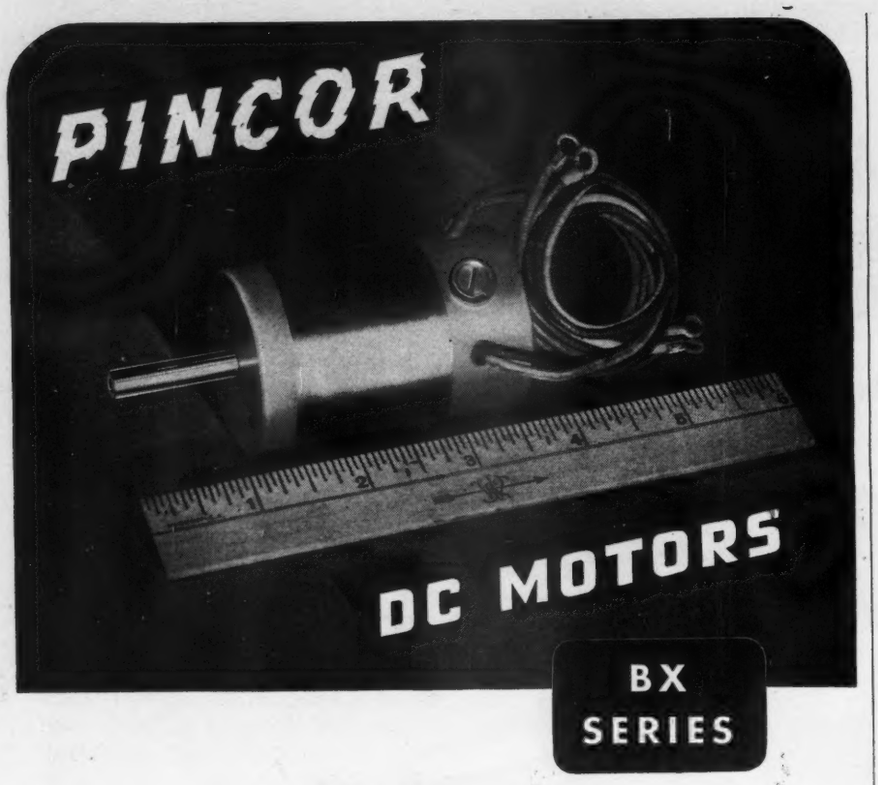
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY



Pincor BX motors, in their classification, meet the varied requirements of manufacturers who demand light weight, compact motors for efficient and dependable application. Pincor BX motors are direct drive, ball bearing, high speed units wound for continuous or intermittent duty. Shunt, series or split series windings are for operation on 12 to 24 volt battery systems currently used and may be easily modified to meet your product demand.

Depend on these rugged Pincor quality-proven motors in the BX series. Send your problem to Pioneer engineers and let them put their years of experience to work for you. Consultation with these men will not obligate you in the least.

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BUY MORE BONDS!

Electran Corp. Officers

Frank J. Strassner is president of the newly organized Electran Corp., 207 Railroad Avenue, Harrison, N. J. The concern manufactures rectifier unit and power transformers in sizes up to 100 kva. Other officers are: Vice-president, Robert Carlson; secretary, Frederick E. Strassner, and treasurer, John Fernicola. Frank J. Strassner is an E.E. graduate of Purdue University, class of 1907, and his son Frederick was graduated from MIT in 1938. The older three members of the firm have been associated together for the past 20 years, with the American Transformer Co. and the Newark Tranformer Co.

Mepco Expands

Madison Electrical Products Corp., Madison, N. J., is now set up to produce standard and special types of resistors, if and rf transformers, oscillator and antenna coils, coordinated loop antennae trimmers and meter multipliers, as well as special production assemblies such as vacuum tube voltmeters, oscilloscope testing equipment, circuit analyzers, audio and radio frequency oscillators, etc.

Clare Eastern Offices

C. P. Clare & Co., Chicago manufacturers of relays, has opened new engineering and sales offices at 420 Lexington Avenue, New York, and in the Commercial Trust Building, Philadelphia. J. W. Concagh, with a background of fifteen years' experience in the relay and electrical equipment field, will be in charge of the New York office. Frazier O. Stratton will be in charge at Philadelphia.

Cinch Buys Jones

Cinch Mfg. Corp. has purchased the assets of the Howard B. Jones Co., both of Chicago. The employes of the latter company will be retained for the most part, and Howard B. Jones will be connected with Cinch in a consultant capacity on the Jones products. All incompleted orders remaining on the books of the Jones company at opening of business on the day of transfer of assets will be manufactured and shipped and it is planned to continue the production of all the Jones products.

LONG SCALE, WIDE RANGE VOLT-OHM-MILLIAMMETER

DOUBLE SENSITIVITY
D. C. VOLT RANGES
0-1.25-5-25-125-500-2500 Volts,
at 20,000 ohms per volt for greater accuracy on Television and other high resistance D.C. circuits.
0-2.5-10-50-250-1000-5000 Volts,
at 10,000 ohms per volt.

A. C. VOLT RANGES
0-2.5-10-50-250-1000-5000 Volts,
at 10,000 ohms per volt.

OHM-MEGOHMS
0-400 ohms (60 ohms center scale)
0-50,000 ohms (300 ohms center scale)
0-10 megohms (60,000 ohms center scale)

DIRECT READING OUTPUT LEVEL DECIBEL RANGES
−30 to +3, +15, +29, +43, +55, +69 DB

TEMPERATURE COMPENSATED CIRCUIT FOR ALL CURRENT RANGES D.C. MICROAMPERES
0-50 Microamperes, at 250 M.V.

D. C. MILLIAMPERES
0-1-10-100-1000 Milliamperes, at 250 M.V.

D. C. AMPERES
0-10 Amperes, at 250 M.V.

OUTPUT READINGS
Condenser in series with A.C. Volts for output readings.

ATTRACTIVE COMPACT CASE
Size: 2½" x 5½" x 6". A readily portable, completely insulated, black, molded case, with strap handle. A suitable black, leather carrying case (No. 629) also available, with strap handle.

LONG 5" SCALE ARC
For greater reading accuracy on the Triplett RED ● DOT Lifetime Guaranteed meter.

SIMPLIFIED SWITCHING CIRCUIT
Greater ease in changing ranges.

Write for descriptive folder giving full technical details

Precision first ...to last

Triplett

STANDARDS ARE SET BY TRIPLETT

ELECTRICAL INSTRUMENT CO. **BLUFFTON, OHIO**

★ TELEVISION TODAY* ★

New Developments in the Video Field

CBS DEMONSTRATES ITS COLOR TELE

(*Continued from page* 75)

done by pointing the axis of this dipole reflector directly toward that building.

This test, while it could be equally well applied to the 50- to 90-megacycle waves would require such a large reflector at the receiver as to be unwieldy. It gives assurance that, while the extreme facility whereby these radio signals are reflected off building structures is in no means altered, a means is available of making use of such signals when direct path reception is not possible. This test was one of the most interesting parts of the demonstration.

Combined sight and sound

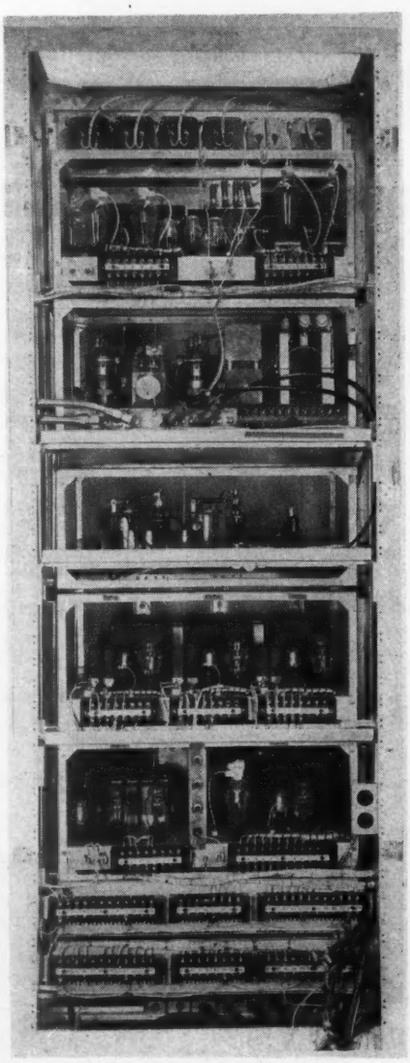
In these tests a receiver having the following characteristics was used covering the reception frequency of 480-500 megacycles, with a pass band of 9 megacycles, as shown in curves. This receiver had a combined sight and sound IF channel with the sound signal picked off at the second detector as a series of frequency modulated carrier pulses occurring during the scanning flyback intervals. These pulses are demodulated and integrated into a regular audio signal with circuits that were not disclosed. In the present system 31,500 of these pulses occur each second permitting an audio fidelity of 10 or 12 kilocycles.

The receiver had a sensitivity of 8μV at the unity S/N ratio point and gave a satisfactory picture with 150μV input. The first "tube" was a silicon detector followed by a six-stage IF amplifier operating at 105 megacycles. This amplifier utilized stagger tuned coupling, with 6AK5 tubes. Extreme precautions were taken to secure sufficient image rejection and avoid direct pickup at the intermediate frequencies. Following this was the second detector and two video stages modulating a 10 in. cathode ray tube with a P4 screen, operating at 8 kv.

The color definition was excellent and there was no apparent separation of colors on fast moving objects. Also there was no noticeable flicker at the illumination level shown. However, the light output was considerably under that generally deemed necessary for viewing in a subdued-light room, although the illumination was more than adequate for a darkened room. The amount of flicker at greater brilliancies was not demonstrated.

As is usual in all presently-workable color television systems, a succession of three colored films (here mounted on a rotating disc) pass between the cathode ray tube screen and the observer, each imparting its own color to the portion of the frame then being scanned. By a systematized order of scanning, the twenty complete frames are broken up into 120 fields per second, so that each color appears 40 times per second. This same system having been applied at the studio camera, all colors are reproduced in correct order and correct intensity. At the studio, however, particular color intensities can be modified or intensified if it is desired to correct for inaccurate intensities of the viewed scenes (as with filmed pictures) or to make drab scenes more vivid.

Rear view of Federal-CBS tele transmitter modulator unit, one of the ten bays



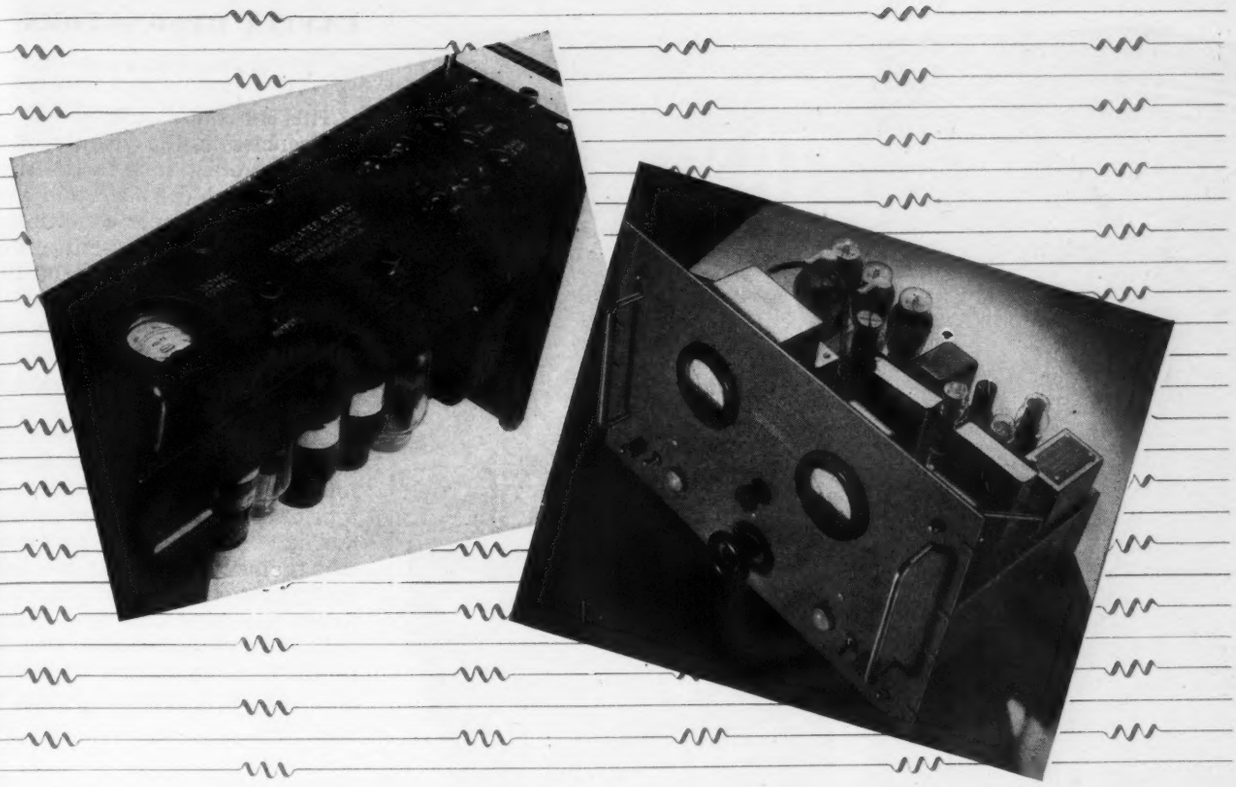
The rotating color wheel operated noiselessly and at a 1200 RPM speed carried six color film sectors, two reds, two greens and two blues. Non-mechanical color systems (such as full electronic color methods) are still in the realm of wishful hoping, it would seem from all reports.

Coverage problems

The problems still to be studied are those of coverage. Frequencies of this order do not produce a utilizable signal behind hills or around obstructions, and locations in a valley may be without signals unless other obstructions are strategically located to "radar" a signal into the valley. The possibility of using elaborate multiple arrays at a receiver to reduce reflected path multiple signals is not always a complete advantage since simple dipoles alone that prove satisfactory at the present television frequency range, are generally inadequate. These, and other factors make it difficult to answer the question everyone is asking—will color television supersede black and white immediately. On the practical side, these proposals are those of a single organization and while quite unusual demonstrations were made, the final system must be proved in many other equally important ways to avoid the repetition of the accusation that the present black and white system was settling down on

(*Continued on page* 124)

*Title registered U. S. Patent Office.



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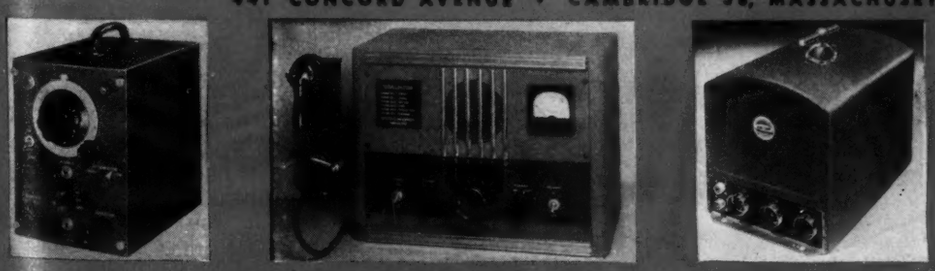

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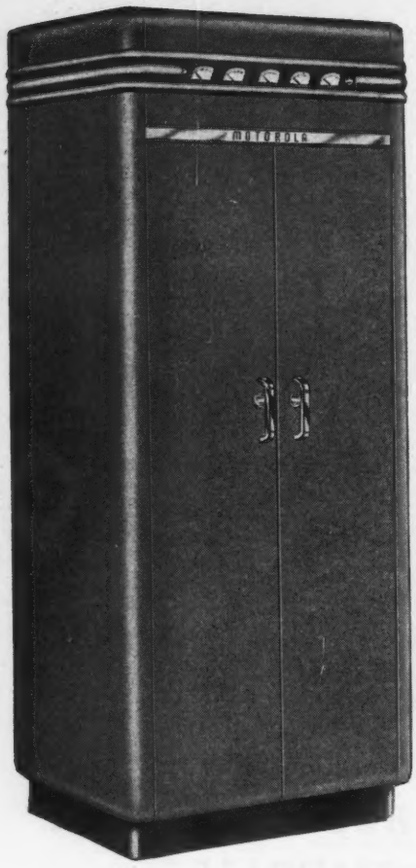
Typical HARVEY products: Above *left*: The HAR-CAM Visual Alignment Signal Generator Model 205 TS; *center*: The HARVEY Marine Radio Telephone Model M-25; *right*: The HAR-CAM Model MFT-25 FM Transmitter. Write for Bulletins.



Illustrated is Motorola's newest contribution to this field—the Model FSTRU-250-BR 250-watt Central Station Transmitter - Receiver Unit, designed for the newly-established 152-162 mc. band.

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CAVITY RESONATORS

(*Continued from page 82*)

This is because at these very high frequencies in the vicinity of 3000 mc, the transit time in the tube is an important consideration in the setting up of proper conditions for oscillation. In this re-entrant cavity, the transit time in the lighthouse tube is such that the conditions for oscillation are satisfied in the region from 8 to 12 cms.

In this band the re-entrant resonator can be used as a cw or as a pulsed oscillator with power output and efficiency about the same as for the double coax circuit. This type of oscillator has been produced during the war, and photographs of two production cavities are shown in Figs. 3 and 4. In Fig. 3 the lighthouse tube and grid cylinder are shown removed from the cavity to illustrate the shape of the tube and the construction of the grid cylinder.

Tuning controls

The production cavities were made with two tuning controls. One was a coarse tuning control, which tuned approximately 60 mcs per 360° turn, and the other a fine tuning control, which tuned approximately 20 mcs per 360° turn. In use, the coarse tuning would be set up on the bench, and then the fine tuning control would be brought to the panel so that minor adjustments could be made in operation. The unit in Fig. 4 has a monitor output. This was used to take out power at a very low level so that the frequency could be monitored constantly. In this way the set could always be kept in tune, and with the wavemeter used, the frequency output could be held to approximately 1 mc. This unit was designed to operate in the five-quarter mode, and its overall length is aproximately 8½ in. It has an additional feature of frequency wobble.

This frequency wobble was needed to vary the frequency output of the cavity over a given range, determined by the amount of drift the transmitter would experience in use. In this way some energy at the proper frequency would always be available even though it would not be available 100% of the time.

Frequency wobble is introduced into the cavity by means of a probe mounted on a small dc motor.

When in use this probe acts as a variable load on the transmission-line tuned circuit and thereby varies the frequency output of the oscillator. The speed of the dc motor is controlled by varying the voltage applied to it. As can be seen, there is an adjustable stop on this probe so that when constant frequency output is desired the probe can be clamped in position.

The unit in Fig. 3 was designed to operate in the three-quarter mode and had an overall length of aproximately 6½ in. This overall length does not include the fine tuning control, which in this case was brought out through a hole in the panel of the set for which this cavity was designed. Power is taken from both of these units with a capacitance probe, which is inserted in the output clamp and adjusted for maximum power output, then locked in place.

Operating range

The operating range of both of these cavities is approximately the same, and with the use of three grid cylinders and three shorting plug positions, the cavities can be made to operate from 8.9 to 11.1 cms. These cavities were both designed for pulsed ouput. The peak power available from these units was from 50 to 100 w. Each of these cavities also could be used for cw operation providing the necessary adjustments were made in grid cylinder length and in shorting plug position.

The tuning mechanisms in both of these units are spring loaded, and since tuning is accomplished by sliding contacts on the plate cap of the tube and on the wall of the cathode line, the spring loading must be strong enough to overcome the friction of both these contacts in order to make smooth, accurate tuning possible.

In production it was found necessary to use a beryllium copper plate-line and a beryllium copper shorting plug. This was necessary so that accurate jig heat treating could be performed after fabricating to maintain the close, accurate dimensions and spring necessary for uniformity in tuning of all the cavities. Similarly it was found that beryllium copper was needed in the fabrication of the grid cylinder so that this item would have a firm, tight grip on the flange of the tube and yet be removable

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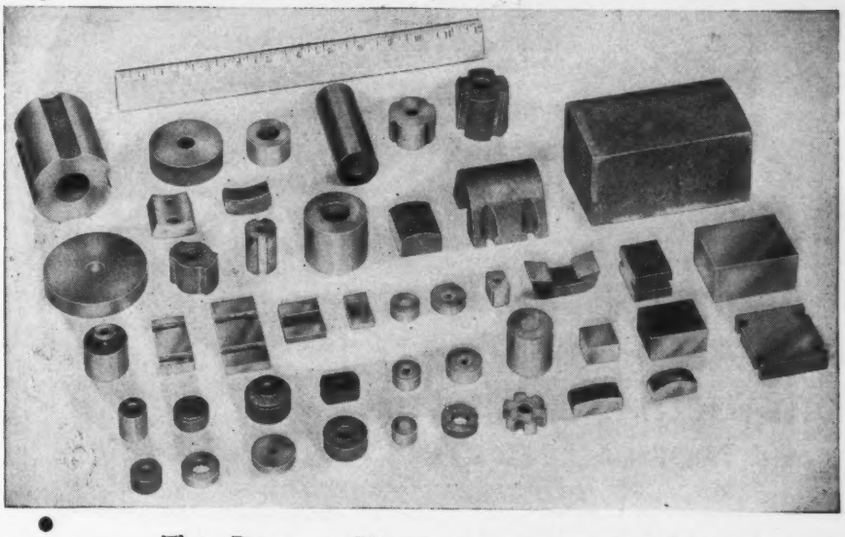

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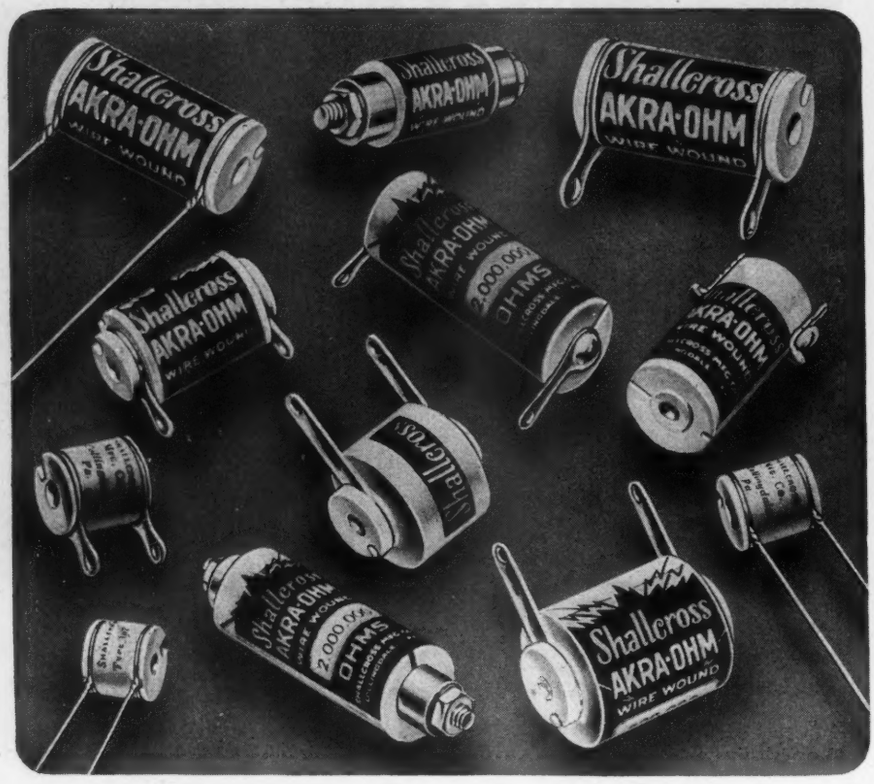

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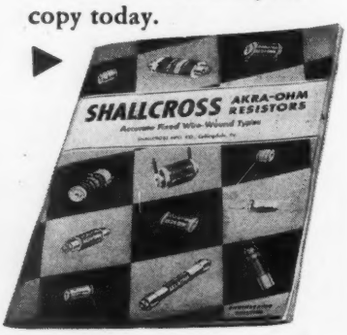

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without breaking the glass structure.

Dc contact was made to the grid by means of a beryllium copper finger insulated from the wall of the cathode line. This finger is designed so that it makes contact to the grid as near a point of voltage minimum as possible so as not to interfere with the operation of the oscillator.

To maintain a uniform production so that all the cavities produced would perform alike, it was necessary to electrically test them very carefully. The following are some of the more important tests performed on the production units:

1. Band Coverage—In this test the production cavity was tuned over its full range to check the limits of oscillation to guarantee that the required frequencies were covered satisfactorily.

2. Power Over Band—This test was performed to insure that sufficient power output was available over the required frequency range.

3. Back Lash—This test indicated whether or not the spring loading was sufficient to overcome the friction due to sliding contact.

4. Breakdown Test—The insulation of the plate line was tested at 3000 v dc to insure proper operation. The grid contact insulation was tested at 500 v to insure proper operation.

5. Frequency Wobble—The frequency wobble of each cavity produced was set electrically and adjusted so that the wobble of each cavity was within a tolerance of 1 mc.

An important requirement for these units was that they pass the salt spray corrosion test specified by the Armed Services. In order to meet this specification, it was necessary to minimize differences in finishes on parts which came into contact with one another. This was done by using a fairly heavy plate of silver wherever it was practical and possible. It was necessary to change the coil springs from steel to beryllium copper in order that the silver plating could be applied more effectively. All the aluminum parts were anodized, such finish being limited only to those parts where it was considered essential. All the machine screws and bolts used in the assembly of the unit were changed from brass to stainless steel.

---

*Lighthouse tubes have become known by this name because of their peculiar shape. Representative of lighthouse tubes are the types 2C40, 2C43, 446, 464.

Much of the research work on cavities for lighthouse tubes was done at Massachusetts Institute of Technology, Radiation Laboratory, Cambridge, Mass.

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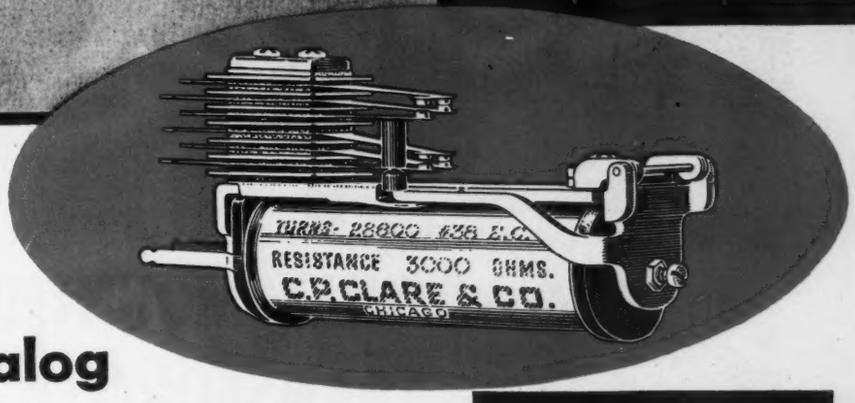

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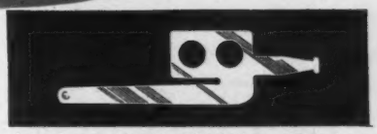

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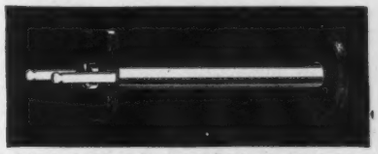

Coil core on d.c. relays is solid rod of magnetic iron, the ends machined to give an absolutely flat surface. One end is drilled and tapped for fastening to heel-piece.

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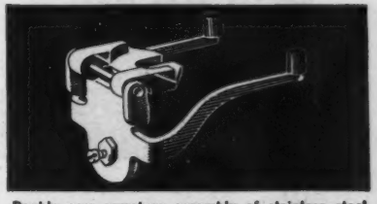

Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly of magnetic metal.

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DF UNIT

(*Continued from page* 79)

the 180° ambiguity. A sense button is pressed, introducing voltage from the sense antenna differentially into the combined loop circuit. This causes the resultant voltage from the loops and the sense antenna to increase or diminish depending on the vector direction of the signal.

For the reception of CW signals, a separate BFO is included. The BFO operating switch controls a relay, applying plate voltage to the oscillator and coupling its output to the screen grids of the two pentode rectifiers. The resultant audio beat has a frequency equal to the difference between the if signal frequency and the BFO frequency, and is fed to an af amplifier which energizes the headset.

The visual bearing indication is also obtained from the rectified signal in each channel, from one diode in each of the duo-diode pentode tubes, and applied to the respective windings of the twin-bearing indicator through suitable load resistances.

COLUMBIA'S COLOR

(*Continued from page* 118)

a basis that was preventing improvement.

The standards selected by the RTPB and adopted by FCC do not cover operation in this region and certainly are, for the most part, not adaptable thereto. Several methods of combining sight and sound are known to be applicable, in addition to that used by CBS. It certainly would be unwise to select any major standards just now without careful analysis of all proposed methods of full electronic color control that will eliminate mechanically rotating parts, so that those standards would not handicap worthwhile developments along that line. So while some of the fears formerly heard (that predicted years of experimentation to get a satisfactory color system on the air) have been proved unfounded, the commercialization of any system to the point of getting FCC sanction that it is the system, requires much experimental field test verification. If past history can be used as a guide, a great many political and legal barriers will be thrown up as well, which can be surmounted in a slower fashion

than the purely technical system difficulties that are so rapidly being solved by enthusiastic engineers and their ingenious ideas.

This demonstration consisted of the following setups. A film scanner was located on the tenth floor of the CBS building at 51st Street and Madison Avenue, New York City, capable of scanning 8 mm color films and larger sizes of colored slides. The output of this scanning system was transmitted to the new transmitter at the top of the Chrysler Building on 42nd Street by coaxial cables. There the signal was broadcast in all directions and was picked up by an antenna on the ninth floor of the CBS building approximately one-half mile away and conducted to the demonstration receivers on the sixth floor below. These receivers were equipped with the usual controls and had a magnification lens between the viewer and the color disc. This lens gave a small degree of magnification (about 20%) so that the picture was equivalent to that of a 12 in. tube.

Tickets For Hams

The Federal Communications Commission has resumed issuance of new amateur radio station licenses for the first time since the Japanese attack on Pearl Harbor, Dec. 7, 1941.

The action of FCC will clear the way immediately for issuance of station licenses to thousands of men and women who received their radio training in the nation's armed forces and desire to continue their war gained radio experience as a civilian hobby.

In addition, approximately 8,000 persons who took the FCC examination for amateur radio operator licenses during the war, despite the fact that it was impossible to obtain a station license, now will be able to obtain licenses to operate amateur radio stations. Prior to Pearl Harbor, there were 60,000 amateur radio station licenses in the United States. It is estimated that this number will increase to 250,000 in the next five years due to the tremendous upsurge of interest in radio created by the war.

New Machlett Plant

Machlett Laboratories, Inc., long established in Norwalk, Conn., has moved its offices and laboratories to Springdale, Conn. A newly equipped and enlarged plant has been occupied and is in operation.

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B

LORAN

(*Continued from page 93*)

pulse output is derived from this circuit than from the 10 microsecond marker clipper and only the positive pulses from the divider outputs receive attention in this circuit.

The 10 microsecond markers and the 50 and 500 microsecond markers are all positive, but since the 50's and 500's are applied to the lower vertical plate of the cathode ray tube, they will appear as a downward deflection, while the 10 microsecond markers which go to the other plate will appear as an upward deflection.

In practice there is no attempt made to achieve coincidence between the 50 and 500 microsecond markers. The broad 500 microsecond marker always appears delayed behind its associated 50 microsecond marker, and serves only as a tag and not as a measuring point.

Markers every 2,500 microseconds are not derived directly from the third divider stage for the oscilloscope, but are displayed automatically as a slight decrease in every fifth 500 microsecond marker caused by the loading of the third divider stage on the previous stage.

Manual control

The trace shift mixer, included in Fig. 20, takes the square wave output of the receiver gain shift circuit and combines it with the 50 and 500 microsecond markers passing the entire assembly to the cathode ray tube. The amplitude of the square wave on the grid of the trace shift mixer triode is adjustable, and this allows manual control of the trace separation. Three positions are available corresponding to three desired separations during the Loran reading. The first is the normal 1 to 1½ in. spacing for the selection and vertical alignment of the received pulses, while the second removes the trace separation during the actual match. The third separation achieves a slight displacement of the bottom from the top trace in order that the interpolation of markers be possible.

500 Microsecond Marker: Amplifier pips from the second divider, which occur every 500 microseconds, are used as a means of locking the A and B coarse delay

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multivibrators. The 6SN7 triode in Fig. 21 is normally biased to cut-off. The divider output, consisting of negative and positive going pips, is applied to the cathode with the result that only the negative portion reduces the bias enough to permit the flow of plate current. The negative pulses at the plate are then passed on to the delay multivibrators. In other Loran indicator models, the A delay multivibrator is locked on to a 2,500 microsecond marker and in that case the locking is obtained directly from the third divider.

The Framing Circuit: During the process of matching Loran pulses, it is necessary to slide the received signals into their proper positions both on the slow and on the fast sweeps. When the slow sweep position is used, the square wave from either plate of the A delay multivibrator of Fig. 10 may be fed to the first divider storage capacitor. The waveform at one plate is a positive square wave occurring at the recurrence rate of the indicator (i.e., once per sweep) so that it precipitates the charging of that capacitor in a manner similar to the feedback circuit; hence, the first divider will divide at something less than the normal value of 5 as the framing switch is placed in the "right" position, and this will cause the signals to slide to the right. In the "left" position, a similar waveform, but negative, is used; and this slows down the charging of the capacitor so that the signals are drifted to the left.

When the framing switches operate during the fast sweep, the connection to the A delay multivibrator is broken, no change in the recurrence rate is made, and only the slight padding of the crystal oscillator frequency is utilized to position the signals.

Power supply

The indicator power supply of Fig. 22 consists of two sections; one a high-voltage supply for the cathode-ray tube and the other, a regulated low-voltage supply for the timing circuits. Approximately 1,400 volts positive is developed by one half-wave rectifier and this is applied only to the post-deflection intensifier anode on the cathode-ray tube. The negative half cycles from the power transformer are rectified in a similar manner and the developed voltage is about 1,100 volts negative. This forms the prin-

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cipal high-voltage source of the electron gun in the oscilloscope.

In the low-voltage supply, about 360 volts unregulated is furnished to the electronic voltage regulator circuit illustrated in Fig. 23. Here two 2A3 type tubes, acting essentially in parallel, are in series with the load. A dc control amplifier consisting of a 6SJ7 pentode with a glow regulator tube (VR105) is placed between the 2A3 grids and ground. Any changes in the output voltage, nominally 260 volts, is reflected as a change in the potential at the plate of the pentode and consequently as a change in the effective series resistance of the 2A3 tubes. This operates to maintain the output voltage remarkably constant under variations of line voltage so that as much as 15-20 volts variation may be tolerated. The capacitor between the output voltage line and the grid of the pentode makes the regulator action equally good in the case of sudden input changes such as unfiltered ripples.

Scope circuits

The oscilloscope circuits (Fig. 24) used in the indicator are quite conventional and follow those of prewar commercial test oscilloscopes. A wide-neck cathode ray tube, the 5CP1, is used and the use of a post-deflection intensifier anode achieves excellent brilliance. A limiting diode is connected to the grid of the cathode ray tube so that the tube may be turned off during retrace time when the equipment is in the fast sweep position. It will be remembered that the circuit which originates this blanking action is the pedestal generator. The limiting diode is essentially a dc restorer for the application of the pedestal generator square wave to the cathode-ray tube grid.

The receiver, which is contained with its own power supply in a separate chassis, is a wide band superheterodyne having the gain balance feature in the third if stage. It is shown schematically in Fig. 25. There is one preselector stage, a pentagrid frequency changer, three if stages, a simple diode detector, and a single stage of video frequency amplification. The intermediate frequency used is 1,050 kc.

Four fixed channels in the neighborhood of two megacycles are provided, and these are adjusted to

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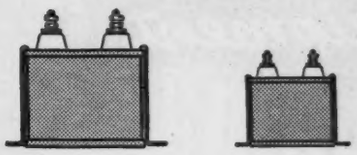
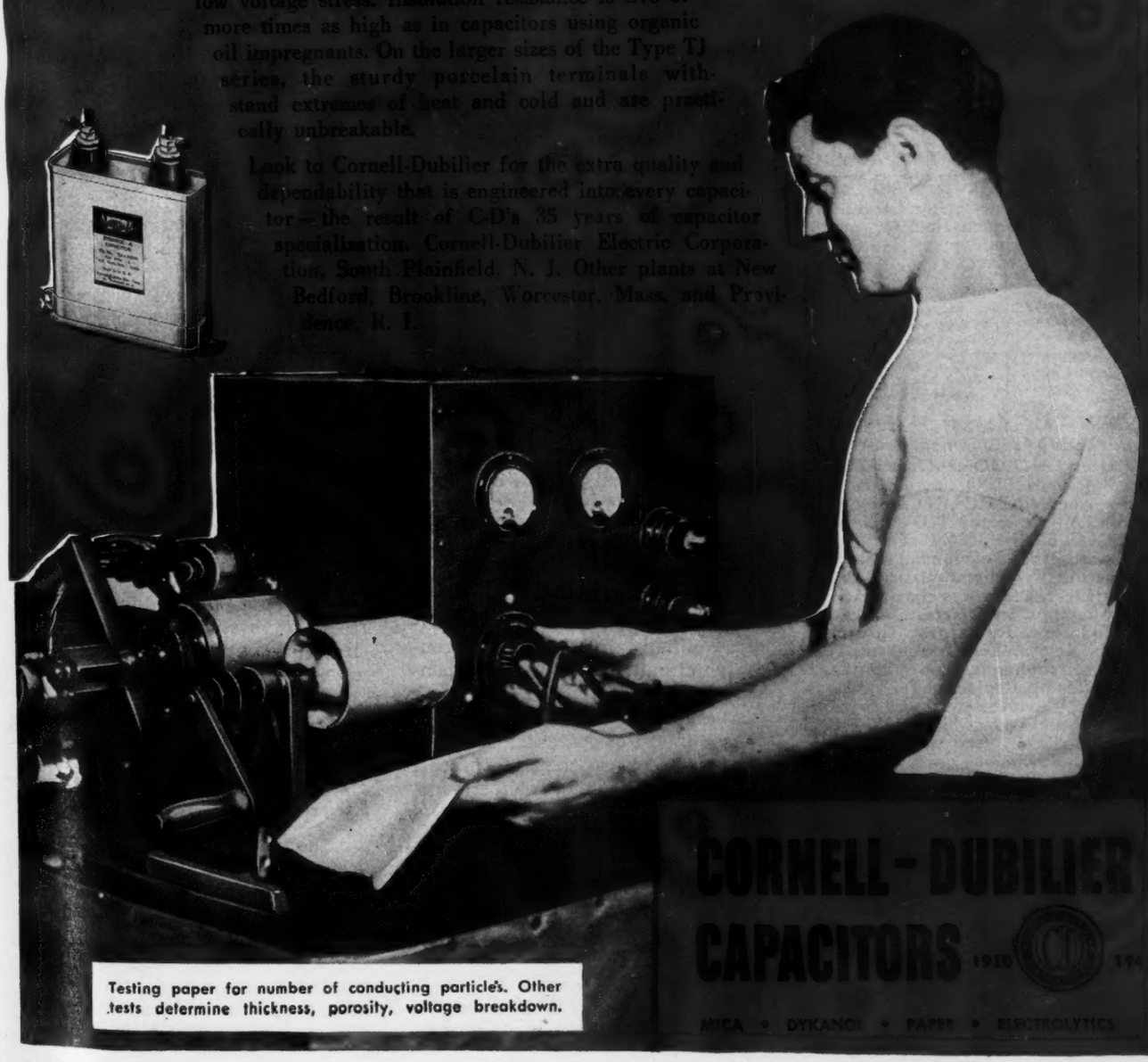
Comparative size of capacitors for same voltage stress using two types of impregnants.



MINERAL OIL C-D DYKANOL



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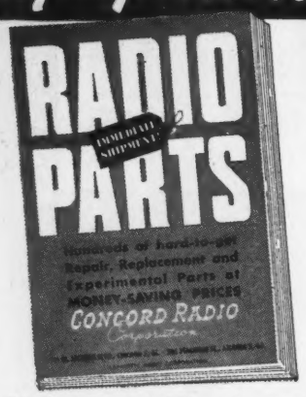

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the desired Loran frequencies by means of permeability-tuned inductances. The overall band width of the receiver is about 60 kc at the half-power points. This band width is necessary if sufficiently sharp pulses are to be received and if sufficient resolution of the pulse train components is to be secured. The overall gain of the receiver is better than 10,000,000, and it is possible to distinguish signals of less than 2 microvolts through the receiver noise.

The video amplifier has an essentially flat response from about 500 cycles to about 20 kc. A high-pass filter is available at the input to the video amplifier for reducing the deleterious effects of keyed cw and most radio-telephone signals. The use of the filter, however, distorts the received pulses considerably but does not greatly reduce the reading accuracy.

The input to the receiver is at low impedance, approximately 50 ohms. The receiver-indicator is usually mounted in the chart room of the vessel so that it is under custody of the navigator. A vertical antenna, anywhere between 30 and 100 feet in length, is preferred and this is rather easily obtained by running a wire from the chart room to the nearest yardarm. A loading unit consisting of a small inductance with appropriate taps is mounted on the bulkhead and inserted between the antenna and the input to the receiver.

Since the appearance of the DAS-1 indicator, other models produced by a variety of manufacturers have been pressed into service. An airborne set, designated as AN/APN-4, was distributed and used in large quantities by the air forces of the USA and the British Empire during the war. In its early versions, the AN/APN-4 differed chiefly in the sweep generator circuit, where a single pentode performed the duties of both fast and slow sweeps, and in the consolidation of switching into one master switch, so that the process of taking a reading was streamlined. Later models of the APN-4 contained in addition a six-stage divider chain,[7] no stage being permitted to count greater than 5. However, this feature led to an unduly complicated system for incorporating feedback into the divider chain.

Later in the war, a lightweight, single-chassis airborne indicator, known as the APN-9, appeared. It possessed a simplified divider chain and delay circuits, a three-inch cathode-ray tube with magnifier, a non-linear fast sweep so that several of the steps in the matching process could be combined, and a decimal system of counting markers. This equipment weighs about 40 lb. with cables and is at present the primary airborne set available for commercial use.

The DAS-1 has been through several revisions, known as the DAS series, some of which contained a pentode sweep, improved systems of switching, and more rugged construction in view of their use aboard naval vessels. At the close of the war, a direct-reading instrument, the DBE, ideal for deck mounting, was made available. It dispenses with the necessity of reading markers, so that once the Loran match has been made, the reading appears on a mechanical counter. It has a novel method of introducing the time difference, all delays being referred to the crystal oscillator sine-wave output by suitable phase shifting.

In the future, Loran indicators may be expected to be even more streamlined for airborne use and undoubtedly will incorporate direct-reading features. The development of lightweight components during the war will make this possible. Simultaneous presentation of two pairs of stations may be expected, too, so that the navigator will no longer need to advance position lines in allowing for the short interval between readings on different rates. Later on, right-left indicators for homing along position lines and for tying in with the automatic pilot may become available. In the event that a low-frequency Loran system becomes operational three-trace indicators may become popular, for the low-frequency system will not contain the disadvantages of long sky-wave trains.

7. Fink, D. G., "The Loran System, Part II", Electronics, December, 1945.

Press Wireless Engineers Move

Although headquarters for actual operations remain in Hicksville on Long Island in New York and executive offices are at 1475 Broadway, New York, engineering personnel of the Press Wireless Mfg. Corp. has practically completed moving into the company's new headquarters at 35th Ave. and 38th St., L. I. City.

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WIDE READING

(*Continued from page 97*)

ized by the diode in the grid lead.

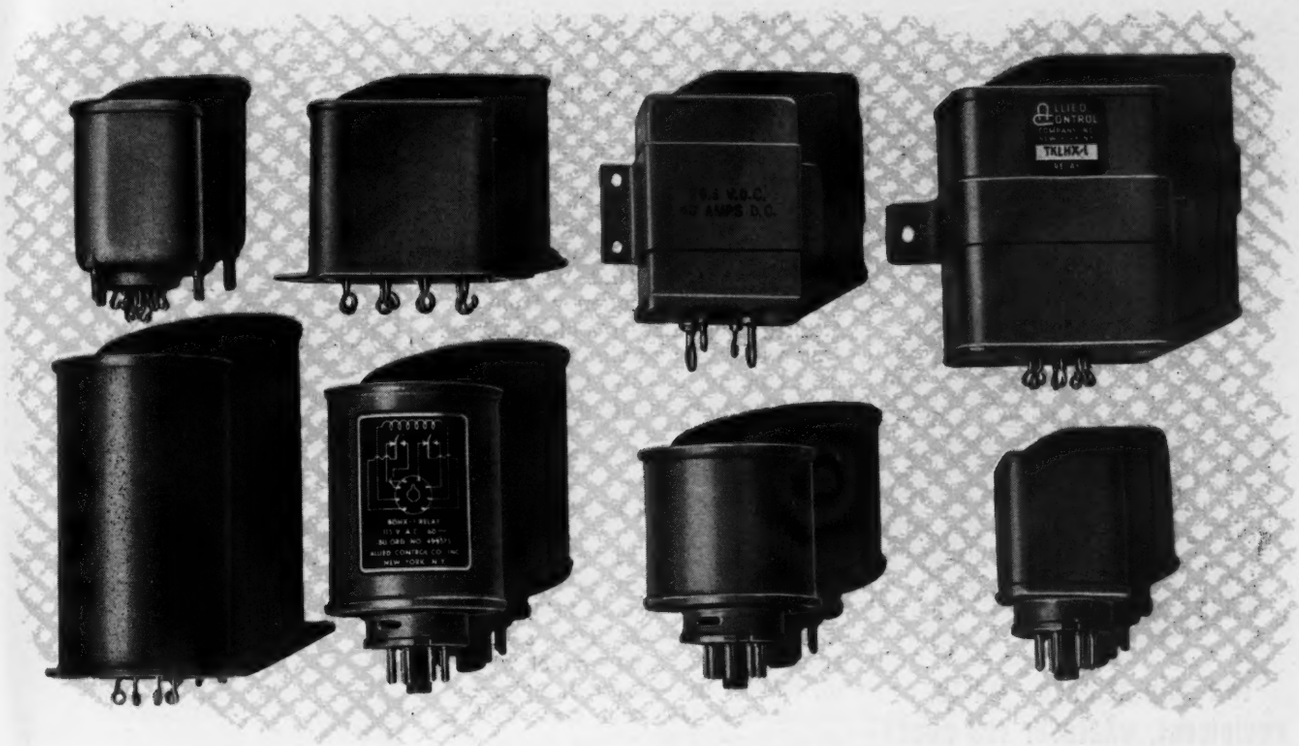
The first grid controls the intensity of the tube current, while the third grid determines the portion of this current reaching the plate. This grid is therefore biased to the center of its linear operating characteristic and the audio frequency signal superposed to effect modulation, resulting in a fairly linear amplitude modulation of the plate current pulse chain. The outputs of all modulator tubes are applied to the grid of cathode follower tube 3.

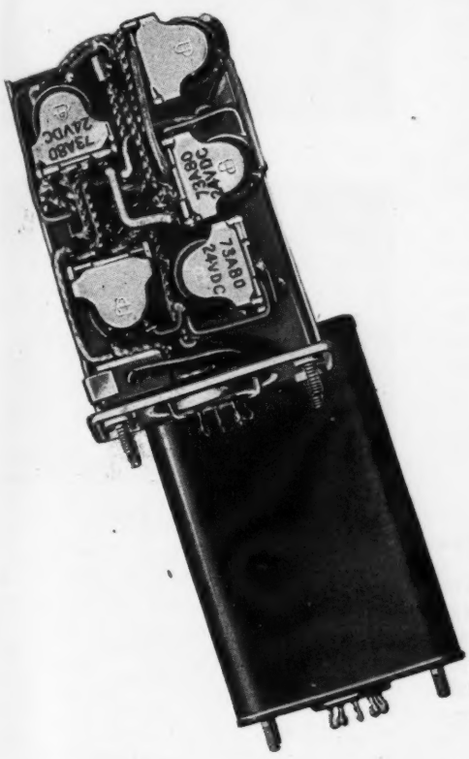
The synchronizing pulse generator is controlled by the sinusoidal signal from terminal S. Zero bias is applied to the third grid of the synchronizing signal tube so that its plate current pulses are at least twice as large as the channel pulses when the latter are not modulated. In order to provide a margin between the peak values of the synchronizing pulses and of a 100 per cent modulated channel pulse, the screen grid potentials on the channel-modulator tubes are made appreciably lower than on the synchronizing pulse generator. The synchronizing signal is also applied to the cathode follower 3 which is connected to a 75-ohm output socket. A plate load on the cathode follower provides a convenient point for taking off a monitor signal.

Receiver

The receiver synchronizing circuit is essentially an oscillator whose phase is controlled by the incoming synchronizing pulses by a system similar to the one described by K. R. Wendt and G. L. Fredendall in an article entitled "Automatic Frequency and Phase Control of Synchronization in Television Receivers" published in the "I. R. E. Proceedings," 1943, p. 7. Eight 45 deg. phase shifted sine waves are generated by a circuit similar to the phasing unit incorporated in the transmitter. Seven of these sinusoidal waves are applied to the control grids of seven channel-separating pentodes, respectively, operating under similar bias conditions as the pulse generators at the sending end.

All the third grids, however, are fed in common from the incoming composite pulse waveform; each received channel pulse chain coincides with one of the sinusoidal waves derived from the synchronizing signal. Under these conditions the plate output from each of these





The photo above shows a cut-away view and completed assembly of Allied type TKHX-26 sealed relay with ten soldered terminals individually color marked.

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channel-separating pentodes consists of the amplitude modulated pulses of a single channel only. Pulse harmonics are eliminated by filtering and the seven pulse chains are then amplified and made audible in a conventional manner.

In speech tests, independent observers found it impossible to distinguish transmission through the equipment from that passing directly at audio frequency from the transmitting micro-telephone. Cross talk was just audible on the adjacent channel, but unintelligible. The effective audio band was from 200 to 3,500 cycles.

RCA COLOR TV

(*Continued from page* 102)

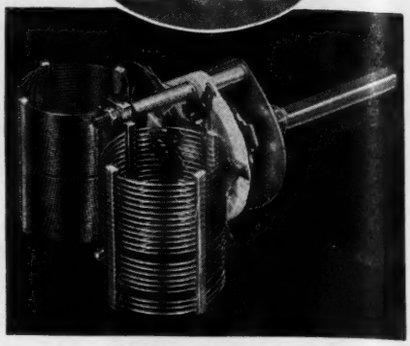
Delivery of receivers is planned in the third quarter of 1946. Prices: Old model pre-war TRK sold for $600; the new table model with 7 in. tube giving television sight and sound only, $150. The same with a 10 in. tube, $195. (This model will be available first.) Console with 10 in. model and a 12 in. loud speaker, $250; the same with FM and AM reception added, $295; with Victrola added, $395. A 15 in. direct view receiver with FM and AM, $400. Projection receiver, picture size 16 in. x 21 in. with FM and AM, $495. These are not firm prices.

To summarize up to this point, it was the belief of several present that the 10 in. direct view picture gives most value for the money. Projection receivers are definitely in the de luxe class and actually will not give the purchaser, if his family group is less than 20, any more than the smaller receivers, except pride of ownership.

Image Orthicon camera

In another laboratory R. D. Kell explained and showed the Image Orthicon camera which will operate not only on very low light values, but without manual adjustment will accept a very wide range of illumination satisfactorily. A young lady was seated in front of the camera, illuminated by two very large spotlights. The picture was shown in the same room on a projection receiver. The illumination was then reduced to one 60 w lamp. The next step was to reduce it to four paraffin candles, and finally all but one of these candles were extinguished. The remaining picture was quite distinguishable and, of course, for demonstrating purposes very striking. Surprisingly,

B&W



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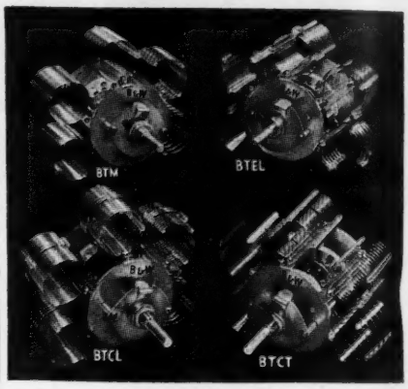

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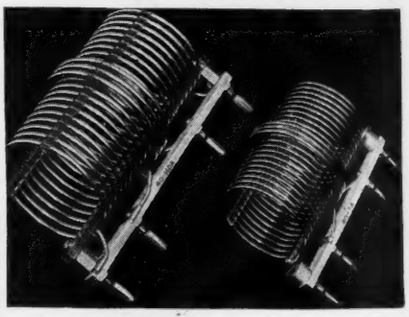

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the audience did not applaud or seem moved.

Next it was pointed out that RCA was transmitting the voice signals which go with the television picture not by using a separate FM transmitter as is common practice, but by transmitting these signals at the edge of the picture—in other words, during the time of the return trace of the television scanning beam. This was shown also on the projection receiver where at the edge of the picture the sound waves could be seen "wiggling".

While in this laboratory the group was told to look at the experimental studio arranged in one corner for color television demonstrations because it would be used during the afternoon when the visitors were at the receiver observing the picture. The temporary studio occupied about 20 x 30 ft. of floor space. This was illuminated from overhead by fluorescent lamps arranged in curved reflectors side by side so the whole ceiling was practically covered by fluorescent lamp tubes. Also about 20 of these arranged in an arc were placed on both sides of the stage for front illumination. The fluorescent lamps were arranged alternately, "daylight" type and "white" type. The illumination was bright, but not dazzling. There was practically no heat. The nearest flourescent lamp was probably 8 ft. from an actor's face. The camera used for color pick-up was an Image Orthicon to which had been added a color scanning drum with a similar drum at the receiver revolved in synchronism.

Color television

After luncheon the visitors were taken to the Princeton Inn located about 2 air miles from the laboratory. Here they assembled in a downstairs darkened room before an experimental receiver in which a direct viewing tube 12 in. in diameter was used.

A color chart was first placed before the camera and then a young lady, wearing a light green dress on which vari-colored flowers made of cloth were printed, sang. She had auburn hair and her cheeks looked highly rouged; a performer-master of ceremonies put on an act of blowing up colored balloons and forming them into the shapes of different animals; two girls, one blonde, one brunette, appeared to select colored scarves and to drape them on their shoulders so as to show the various color contrasts. This program was repeated three

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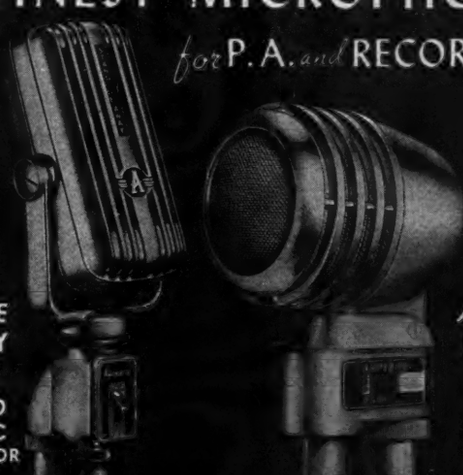

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times to give all of the audience a chance to move in turn into the front seats. The demonstration was carried out without a hitch. It was transmitted on a frequency of 9500 mc. The pictures had 525 lines, three colors. The picture repetition rate was 40 per second. The modulating band width 12 mc; sound was transmitted with the television picture.

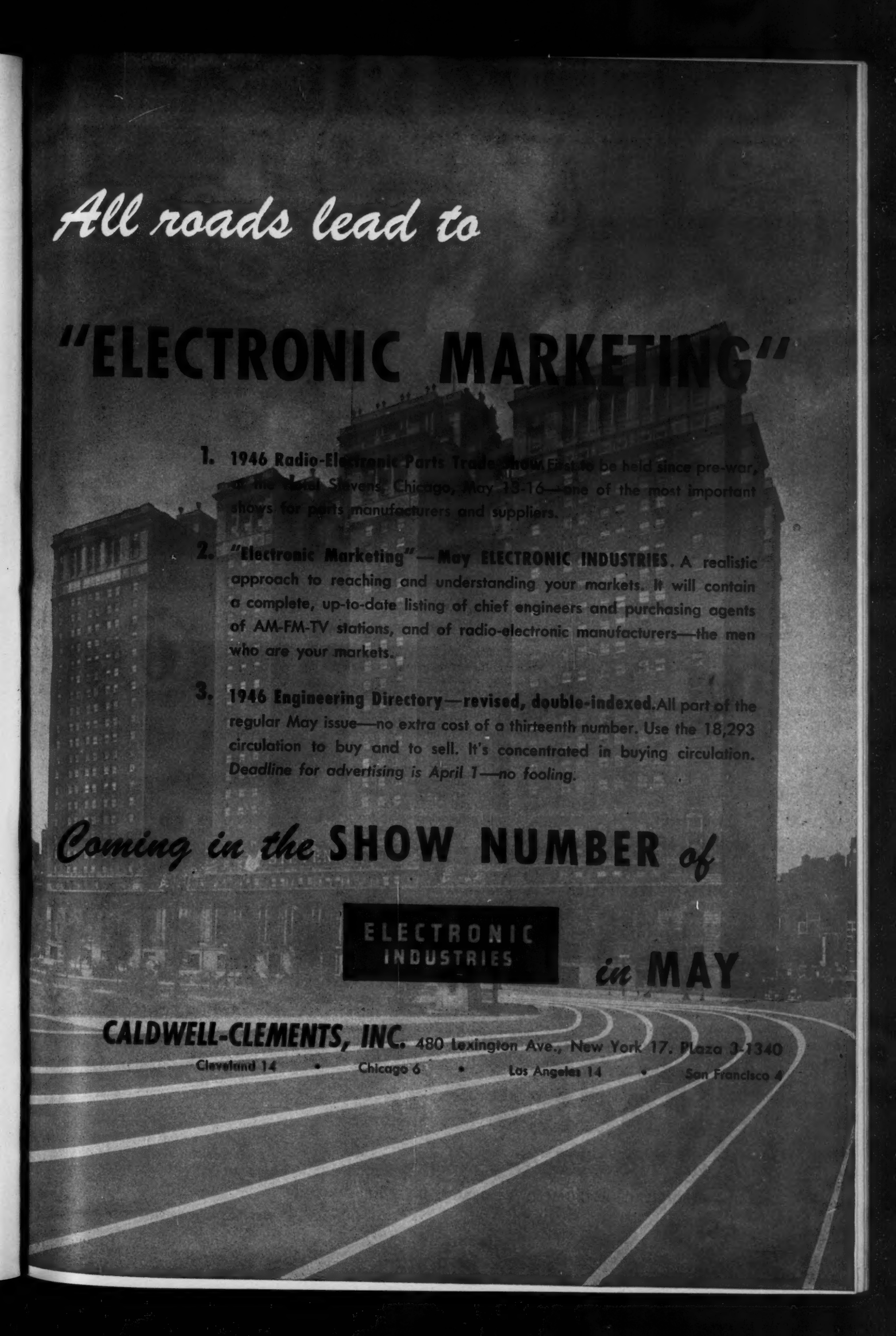
At the conclusion of this demonstration Dr. Engstrom made a statement setting forth to the visitors RCA's viewpoint on color. Briefly, it was this. RCA's color research had now advanced about as far as their black and white television was in 1930. There have been no field tests, no standards have been set. RCA will join with others when the time comes to try to fix these standards. RCA is vigorously carrying on improvements in color television. The time needed to make it commercial is at least five years. Color does add something to television. However, at the present time black and white television has been developed to the point where it is ready for commercial exploitation.

Stereoscopic television

At the conclusion of the color television demonstration a brief showing of stereoscopic television was made. The observer, who had to stand close to the television receiver, was given Polaroid glasses. The method by which stereoscopic vision was afforded was identical with that used in the motion picture industry. The several guests with whom our reporter talked did not think that stereoscopic television was worth while. RCA made no comments as to its value.

Makes Rotary Switches

Grigsby-Allison Co., Inc., has been organized in Arlington Heights, Ill., to manufacture equipment for radio band switching and for use in instrument manufacture. Initial production will be concentrated on rotary switches with push-button switches and tuners to follow. R. J. Grigsby, who heads the company, was formerly vice-president of the Oak Mfg. Co., Chicago, and later vice-president and sales manager of Allied Control Co., New York. He is also chairman of the board of the Grigsby-Grunow Co. K. C. Allison was for 13 years production engineer for the Oak Mfg. Co. B. J. Grigsby is treasurer and a director of the company.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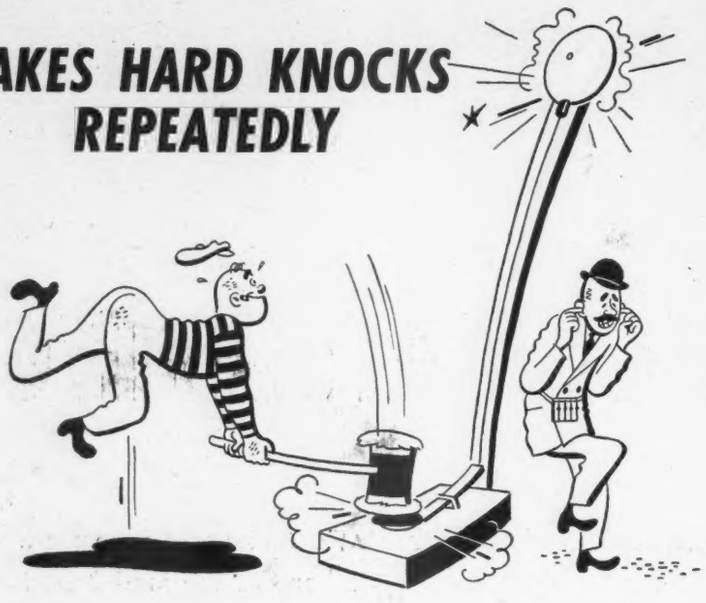

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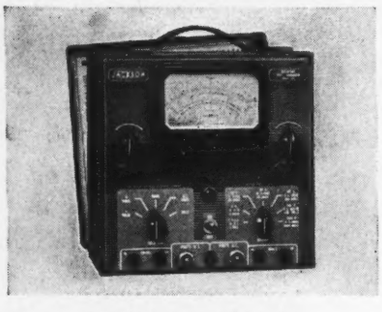

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Measures resistance up to 1 billion ohms (1 thousand megohms)—and as low as 2/10 ohm.

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Over 4 million ohms per volt sensitivity on 0-1 volt A.C. range. Input resistance of 4.4 megohms on all A.C. ranges. Flat frequency response between 50 cycles and 200 kilocycles.

Meter cannot be damaged by accidental overload on any electronic range. Electronic overload protection on all A.C. and D.C. volts, and ohms ranges. Variations in line voltage do not affect accuracy within the range of 100 to 125 volts. Equipped with ballast control tube and self-compensating circuits.

Contains 3 tubes (6X5GT/6K6GT/7N7), neon regulator, 1-4½ volt battery and ballast; self-contained, furnished with the instrument.

Meter ranges—

A.C. Volts: 0-1/4/10/40/100/400/1000
D.C. Volts: 0-4/10/40/100/400/1000
Ohms: 0-1000/10,000/100,000/1meg/10meg/100meg/1000meg
M.A.: 0-1/4/10/40/100/400/1000
Decibels: Minus 30 to minus 5/minus 10 to plus 15/10 to 35/30 to 55

Either positive or negative D.C. voltmeter indications instantly by means of reversal switch. Signal Tracing type test lead, isolation resistor in probe.

Dimensions—8½" x 8½" x 6"—Unit welded steel case, grey morocco finish.

JACKSON

Fine Electrical Testing Instruments

JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO

NEW BULLETINS

Variable Rectifiers

A color folder issued by Richardson-Allen Corp., 15 W. 20 St., New York 11, N. Y., explains the advantages of variable rectifiers and lists some suggested applications for custom built units. In the standard models the dc output is variable from no load to full load. The units are small, compact and permit easy moving if necessary.

Marine Equipment

The many electronic units developed by General Electric Co., Syracuse, N. Y., for marine navigation and communication are shown in a color booklet just issued. The Electronic navigator, a radar instrument; two way radiotelephone transmitter-receivers; depth finder and a small ship direction finder are among the navigational aids described.

Infrared Ovens

Constructional details and the heating characteristics of Raymersion pre-fabricated infrared ovens are shown in a pamphlet by Trumbull Electric Mfg. Co., Plainville, Conn. Lamp mounting angles in these insulated units are engineered to provide complete product immersion in the infrared radiation and circulating convection heat.

Punching Equipment

A complete catalog, covering descriptions of the individual units used in this hole punching equipment, has been issued by Wales-Strippit Corp., 345 Payne Ave., N. Tonowanda, N. Y. The re-use of interchangeable self-contained punching units permits the development of unlimited punching designs.

Kovar-Glass Seals

Of particular interest to companies engaged in glass working operations, a new bulletin, No. 145, published by Stupakoff Ceramic and Mfg. Co., Latrobe, Pa., gives detailed technics for making glass seals with Kovar. Characteristic properties of Kovar and its available standard shapes and sizes are included. Stupakoff has also prepared special literature for those wanting to purchase finished Kovar-glass assemblies to be used as terminals in hermetically sealed units.

Now...

ACCURACY within ±1/5%

Plus...

CONTINUOUS AUTOMATIC RECORDING of EXPANSION and CONTRACTION MEASUREMENTS

with the new

SYLVANIA DILATOMETER

THE SYLVANIA DILATOMETER measures expansion and contraction by the concentric quartz tube principle... providing the extreme accuracy characteristic of this method.

Simultaneously it automatically *records* the measurements . . . plotting them in the form of a complete elongation-temperature curve for an entire 8-hour cycle.

No special attention is needed to operate this new instrument. Simply insert the specimen and start the equipment. No laborious, time-consuming plotting of curves. The record is continuous. With indicating-type instruments, it is often difficult to take readings fast enough to follow true changes in length at critical points. The recording instrument overcomes this difficulty.

This Dilatometer is one of many electronic devices pioneered by Sylvania Electric. Inquiries are invited.

SYLVANIA ELECTRIC

Electronics Division . . . 500 Fifth Avenue, New York 18, N. Y.

MAKERS OF ELECTRONIC DEVICES; RADIO TUBES; CATHODE RAY TUBES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

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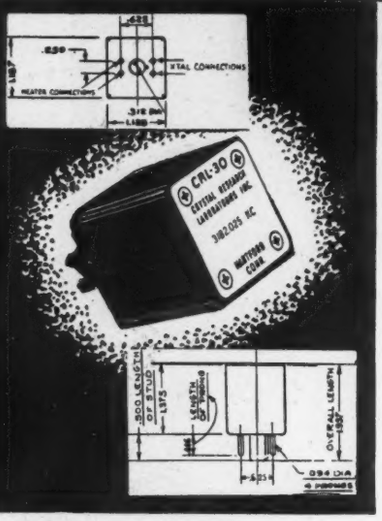
TRADE MARK REG. U. S. PAT. OFF.
SPECIALISTS IN SPECIAL CRYSTALS



SPACE SAVING
FREQUENCY STABILITY

Especially suitable for applications for close frequency tolerance . . . VHF services — police, aircraft, railway communications, etc. . . . works on 6.3v at 1 amp. . . . temp control within ±3°C. . . . operates at 60°C. . . . frequency control of ±.005% . . . frequency range 3MC to 14MC . . . fits octal socket . . .

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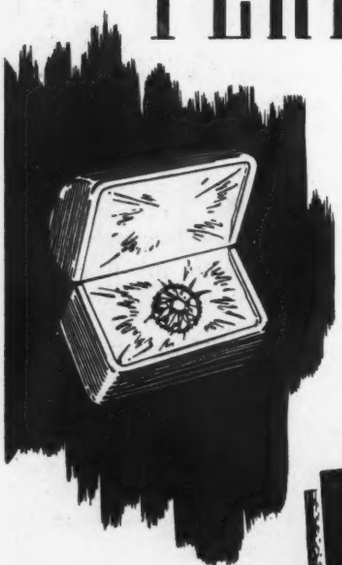
PERFECTION



A fine-cut diamond is perfection in beauty and formation. But to you as a transformer-user, perfection lies in performance, day in, day out, under the exacting conditions of your particular application.

Finest engineering talent and most complete electronic laboratories are ready to consult with and help you with your problem—and to design and produce the transformer that will give you perfection in performance.

ELECTRONIC Engineering COMPANY
"SPECIALIZED Transformer ENGINEERS"
3223-9 W. ARMITAGE AVENUE · CHICAGO 47, ILLINOIS

Timing Units

Covering many of the standard models and special designs of repeat and interval timers, time delay relays, contactors, interrupters and other timing devices a new bulletin has been issued by Haydon Mfg. Co., Inc., Forrestville, Conn. The basic timing motor unit with proper gear trains will provide shaft speeds of from 450 rpm down to 1 revolution in 1,000 hours. Haydon engineering service will help design special units for any specific timing problem.

Airplane Radio

A four-page folder describing a new personal plane radio transmitter and receiver has been issued by Electronics Dept., General Electric Co., Syracuse, N. Y. The complete unit weighing only 12 lb. transmits on a frequency of 3105 kc and the receiver tunes from 200-420 and 550-1500 kc.

Selenium Rectifiers

Electrical characteristics and physical dimensions of some of the models of the selenium rectifiers made by Radio Receptor Co., Inc., 251 W. 19th St., New York 11, N. Y., are included in an 8-page booklet. A page is devoted to normally used rectifier circuits and the operating responses of typical rectifiers under these conditions.

Precision Castings

The Austenal Laboratories, Inc., 224 E. 39th St., New York 16, N. Y., pictures the various steps in the Microcast precision casting process in a new booklet. Many finished castings and suggested uses are shown, together with the physical and chemical properties of vitallium when cast by the Microcast process.

Coaxial Connectors

A folder illustrating twelve types of connectors and two low pass filters for use with coaxial cables has been issued by Diamond Instrument Co., North Ave., Wakefield, Mass. This Company also manufactures many precision parts for special diversified applications in the radio and electronic industry.

Polyvinyl Materials

A 16-page booklet showing the properties and suggested industrial applications of Geon resins, plastics and latices has been published by

American Beauty

ELECTRIC SOLDERING IRONS

are sturdily built for the hard usage of industrial service. Have plug type tips and are constructed on the unit system with each vital part, such as heating element, easily removable and replaceable. In 5 sizes, from 50 watts to 550 watts.

TEMPERATURE REGULATING STAND

This is a thermostatically controlled device for the regulation of the temperature of an electric soldering iron. When placed on and connected to this stand, iron may be maintained at working temperature or through adjustment on bottom of stand at low or warm temperatures.

Write for Catalog Sheets 110-1

AMERICAN ELECTRICAL HEATER COMPANY
DETROIT 2, MICH., U. S. A.

B. F. Goodrich Co., Rose Building, Celveland 15, Ohio. These materials are suitable for compression or injection molding, and for dipping and spreading. They provide satisfactory characteristics for wire and cable insulation, electrical conduits, storage battery cases and fuse boxes.

Fluorescent Products

The many uses and colors of fluorescent satins, lacquers, paints, powders and writing materials made by Switzer Bros., 1220 Huron Rd., Cleveland 15, Ohio, are listed in a new folder. "Black Light" equipment and accessories for both permanent and portable installations are shown.

FM Broadcast Equipment

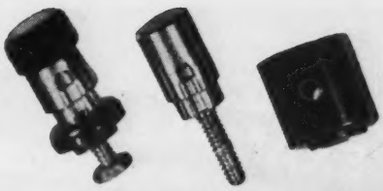
With brief descriptions and pictures of all needed equipment, a new brochure issued by Federal Telephone and Radio Co., 200 Mt. Pleasant Ave., Newark 4, N. J., explains the company's engineering service for the design and installation of a complete FM broadcast station. This engineering supervision covers full responsibility for the design, delivery, installation and tune-up of the complete station. Included are prices and illustrated descriptions of all needed studio equipment items.

Constant Voltage

A bulletin of 32 pages issued by Sola Electric Co., 2525 Clybourn Ave., Chicago 14, Ill., gives a detailed explanation of how Sola constant voltage transformers work and where they can be used to advantage. Illustrations and technical data for each of the standard units are included. The information should be of interest to manufacturers of electronic and electrical equipment which is designed for operation at a specified voltage.

C R Screen Characteristics

Allen B. Du Mont Laboratories, Inc., 2 Main Ave., Passaic, N. J., has issued descriptive sheets of P-11 and P-5 cathode ray screens. These coatings were developed primarily for photographic recording applications. P-11 covers cases where extremely short persistence is not required; the P-5 material has short persistence. Graphs showing average screen and average visual screen efficiency and the spectral distribution of the emission radiation are included.



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From the product designer through to final assembly and use in the field, the Eby Spring Binding Post line offers top service based on dependability.

The spring binding post offers unique advantages that can't be duplicated:

1. No screw cap to tighten or come loose with vibration.
2. Constant, even pressure on the wire at all times in all positions.
3. Easy one-hand feeding of wire into the post.
4. Corrosion - resistant, long-life springs.
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EXAMPLE OF ENGINEERING FLEXIBILITY to meet a specific need

PART LIST No. PL-7287

THIS grid balancing condenser was specially designed for 5 or 10 K.W. Frequency Modulation Radio Transmitters operating in the 100 M. C. range. This is just one of many examples of how Cardwell has developed condensers to meet specific problems. If you have a tough condenser problem, consult Cardwell engineers.

GENERAL CHARACTERISTICS

Capacity Range: 12-6 mmfds. per section

Airgap: .218"

Insulation: MYCROY (glass bonded mica).

Size: Approximately 3" H x 3½" W x 3¾" L.

Material: All aluminum except steel shaft, brass bearings, stator blocks, studs and screws.

Bearings: Ball thrust rear—straight shoulder bearing in front.

Mounting: Foot mounting to chassis or three point to panel.

THE ALLEN D. CARDWELL MANUFACTURING CORP.

MAIN OFFICE: 81 PROSPECT STREET, BROOKLYN 1, N. Y.

FACTORIES: PLAINVILLE, CONN.—BROOKLYN, N. Y.

Radio Components

Alden Products Co., 117 N. Main St., Brockton 64, Mass., has issued a 44-page booklet explaining how its experience in design, engineering and manufacturing complete sub-assembly and special single components will be a help in electronic equipment production problems. The booklet is intended to replace a personal visit to the Alden factory so that the many development specialties available at Alden may be understood.

Radio Station Equipment

Illustrating the modernistic style trend of their television transmitter, studio control console, master control board and audio control console, Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y., has just issued a new two-page folder. Sherron design provides for easy unit additions as requirements grow, covers all equipment from complete transmitters to studio consoles and monitors, etc.

Custom Built Motors

A 32-page color brochure shows many of the special design motors, generators and alternators that Electrical Engineering and Mfg. Corp., 4612 W. Jefferson Blvd., Los Angeles 16, Cal., has developed for specific applications. These cover power generation, pumping, aircraft and marine fields. Several types of gear boxes, actuators and dual rotation motors also are included.

Switch Manual

A catalog, in color, giving electrical and mechanical characteristics and outside dimensions of various types of switches, has been issued by Mu-Switch Corp., Inc., Canton, Mass. Among the special models listed are those for heavy duty dc, special leaf-spring actuators and bracket-type spring plunger actuators for extra rigidity.

Small Motors, Generators

A color brochure issued by Electric Indicator Co., Stamford, Conn., gives mechanical details and operational curves of permanent magnet dc generators and motors, permanent magnet ac generators, series and universal motors and shunt wound dc motors. The company also engineers and builds motors and generators for special applications.

Chicago Engineers Discuss Television

The one-day engineering conference held by the Chicago section of the Institute of Radio Engineers February 9 in the Merchants and Manufacturers Club, Chicago, featured important papers on radio and electronic subjects.

Radio subjects included "Deflection-type High-Voltage Supplies for Television Receivers" by Madison Cawein (Farnsworth); "Aspects of F-M Receiver Design" by Frank C. Gow (RCA Laboratories); "Radio Applications for T-3 Sub-miniature Tubes" by Walter R. Jones (Sylvania); "The Practical Aspects of Intermodulation and Application to Design, Testing, and Maintenance of Audio Systems" by J. K. Hilliard (Altec Lansing); "Radio Receiver Response Trends" by H. S. Knowles (Jensen).

Papers presented before the Electronic section included "VT or Radio Proximity Fuzes" by John M. Pearce (Johns Hopkins Univ.) and Dr. Cledo Brunetti (National Bureau of Standards); "The Loran Navigation System" by Donald G. Fink, Electronics magazine; "Developments in Atomic Energy" by Dr. Robert J. Moon (Atomic Scientists of Chicago); "Interesting Applications of Induction and Dielectric Heating" by John Callanan, and Dr. Eugene Mittleman (Illinois Tool Works); "Human Relations in Engineering" by W. D. Kelsey (Dale Carnegie Institute).

Television HV supplies

In his paper, "Deflection-type High-Voltage Supplies for Television Receivers," Madison Cawein described a simplified, compact combination horizontal deflection oscillator and high voltage supply for cathode ray picture tubes. The circuit described used a single 6L6 as a relaxation oscillator with screen-grid injection for the synchronizing pulses. In the plate circuit of the 6L6 is a special transformer designed to present an inductance of approximately 60 millihenries by reflection of the deflection coil inductance. In the particular application of this circuit, the deflection coils (horizontal) had an inductance of 3 mh, thus the impedance ratio of the transformer was 20:1. This value of 60 mh in combination with the effective resistance of the 6L6 forms an LR circuit which, with a tightly coupled feedback winding operating the control grid, produces a relaxation oscillation of suitable deflec-

ARMY NAVY
FIRST AWARD . . . JUNE 23, 1944
FIRST RENEWAL WITH STAR . . . DEC. 16, 1944
SECOND RENEWAL WITH STAR . . . MAY 26, 1945
IMMEDIATE DELIVERY
METAL CHASSIS, CABINETS
TERMINAL BOARDS
AND STAMPINGS
To Your Specifications

Insuline's complete tool and die shop has the equipment and know-how required to deliver—*almost immediately*—anything a radio or electronics manufacturer might require: anything from a tiny lug to an oversize transmitter housing—in any quantities and to specifications.

A full complement of high-production machinery is available throughout the Insuline plant so that even your most difficult production problems may be solved. Standard terminal boards, metal boxes, cabinets, chassis, as well as special stampings of all kinds can be produced to the most exacting standards. There are special facilities for making receptacles, brackets, and sockets of all types, including dial-light sockets and pilot-light sockets.

Because Insuline's facilities are so extensive, any item you require—complete assemblies, sub-assemblies, or small parts—can be finished within the confines of the Insuline plant.

An Insuline engineer will be glad to discuss any of your production problems with you. If you prefer, send us your specifications, and we will do our best to send you an accurate estimate by return mail.

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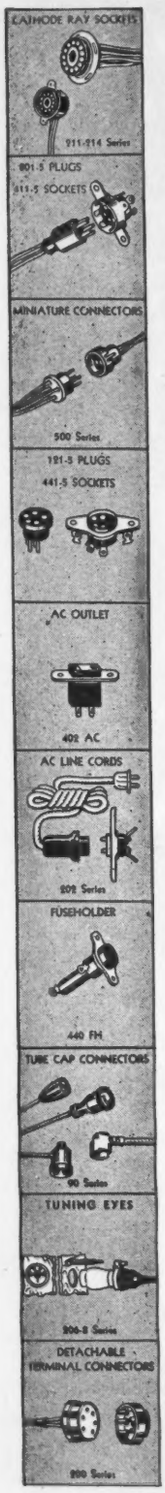
INSULINE CORE OF AMERICA · ICA · TRADE MARK
QUALITY PRODUCTS SINCE 1921

ALDEN
RADIO COMPONENTS



211 AND 214 SERIES CATHODE RAY TUBE CONNECTOR WITH LEADS
Any requirements in a cathode ray tube connector with proper leads attached engineered as an assembly, high safety factors in all kinds of service. Super-long leakage paths, rounded, "coronaless" clips and individual pocket type insulation and strain relief.

801-5 SHIELDED PLUGS AND 441-5 METAL SOCKETS
Shielded plug and socket for automobile sets or for any other equipment where leads must be shielded and shield grounded to chassis. Shield is easy to put on and solder to plug. Supplied with or without shielded cable.

MINIATURE CABLE CONNECTORS 500 SERIES
Famous for connecting AC motors in combination sets and all kinds of "through-panel" work. Overall diameter only ¾". Save labor costs by having our special wire equipment put on leads to your particular needs. Underwriters approved.

121-5 MINIATURE PLUGS AND 441-5 SOCKETS
Compact plug and metal seal socket. Use when you want connector to come directly out of chassis. Leads to your specifications. "Pocket" type individual insulation on each lead and clip.

AC OUTLET 402AC
Smallest possible outlet that can be eyeletted or rivetted to chassis like other components. Tabs designed for easy soldering.

AC LINE CORDS 202 SERIES
Detachable AC line and with socket, neat and compact. Socket eyelets or rivets in place like other components. Underwriters approved.

FUSEHOLDER 440FH
Here is a fuseholder that rivets or eyelets in place like the other components in your set. Cannot twist or turn, has spring to eject fuse if it breaks, and make contact at base of fuse and prevent rattle. Top contact slotted for easy removal of fuse ferrule when glass breaks. Tabs are special design for ease in attaching primary leads of ample size.

90 SERIES TUBE CAP CONNECTORS WITH LEADS
Any requirement in tube cap connectors supplied with leads of proper voltage handling characteristics. Many made special, hundreds of moldings, stampings and wire to draw on.

206-8 TUNING EYES WITH LEADS
Supplied with tailor-made leads. With or without escutcheon and bracket. Individual insulation and strain relief for each lead.

200 SERIES DETACHABLE TERMINAL CONNECTORS
Replaces terminal strips. Supplied with leads. Each lead has individual insulation and strain relief.

WIRE AND CABLE
Any kind of wire or cable laced, braided, woven or assembled with any of our components or those of other make. Many types of wire in stock and in process.

NEW ITEMS
Alden is a specialist in bringing through special electrical assemblies; new samples made promptly.

ELECTRICAL RECORDING INSTRUMENTS
Special instruments to record electrical impulses as they occur with all the minute variations of intensity and duration, free from the lag and inertia of present systems. "Electrographic" recorders we can supply, include a complete line of facsimile recorders, specially engineered recorders for high speed signal analysis, slow speed recorders for day by day events, multi-trace recorders for simultaneous recording of any phenomena that can be reduced to electrical impulses.

ALDEN PRODUCTS COMPANY
BROCKTON 64G, MASS.

tion properties to operate a 10BP4 tube. A variable cathode resistance adjusts the frequency of oscillation while a variable resistance in the control grid adjusts the linearity. A third variable resistance controlling both plate and screen voltage on the 6L6 control the size of the sweep.

A synchronizing pulse of approximately 20 volts is required on the screen grid. In practice, this is obtained by direct connection of the screen grid of the 6L6 to the plate of a 6AC7 synch amplifier. The 6AC7 and screen of the 6L6 draw power through a common load resistance.

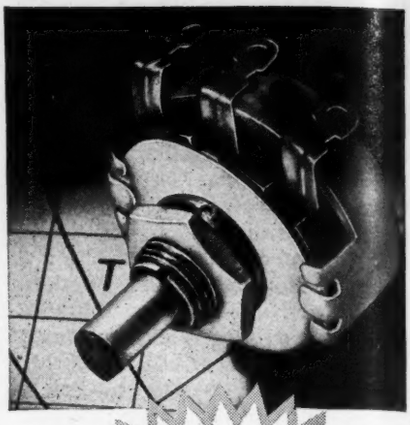
The special transformer has twin hypersil cores. The plate winding is 500 turns of No. 34 wire in pies. The grid feedback winding is 100 turns jumble wound. An additional winding of 300 turns in series with the 500-turn plate winding forms an auto transformer to deliver about 4000 volts to a conventional voltage doubler using two 8016 tubes. Filament power for the 8016 tubes is obtained by two single turn windings on the transformer. A suitable secondary to match the deflection coil inductance is also required.

The power supply delivers about 10 kv at no load, about 7.5 kv at 0.4 ma. load and a maximum of 1.2 ma. with short circuit. With a 1500-ohm load, the current is 0.6 ma. which is well within the 15 ma. limit considered safe by Underwriters.

Cawein said no corona troubles were experienced if wire size was greater than No. 38, laminations were free from burrs and winding voltage was limited to about 5000 volts. Retrace time with the circuit was 12%. Peak voltage on the 6L6 is 2400 volts.

FM design problems

Outlining the problems in receiver design for FM, Frank C. Gow compared performance, advantages and disadvantages of pentagrid converters, separate oscillator and pentode mixer, and triode mixers. Conversion systems were compared on the basis of input conductance, input capacitance, oscillator feedback to antenna and signal input required for satisfactory operation. IF systems were discussed with regard to bandwidth and stabilization of tube input impedance changes resulting from AVC by use of cathode degeneration in various tube types.



It's a CLAROSTAT!

★ And that tells the story. For Clarostat is the name and guarantee of a better composition-element control such as is now found in the finest radio-electronic assemblies where trouble and failure and short-life just can't be tolerated.

The *stabilized* element, exclusive in Clarostat Series 37 controls, sets new performance standards. Extreme immunity to humidity, temperature and other climatic conditions. Rated at 1 watt. Resistance values of 500 ohms to 5 megohms. With or without power switch.

★ **Try a CLAROSTAT . . .**

Don't take our word for it—you be the judge of *stabilized-element* performance. We invite your own test. Write for literature. Submit your control requirements.

CLAROSTAT *Controls and Resistors*

CLAROSTAT MFG. CO., Inc. · 285-7 N. 6th St., Brooklyn, N.Y.

An important fact presented by Gow was the distortion produced ahead of the detector in the form of phase shifts caused, as an example, by loading of tuned circuits if grids should be driven positive. Resulting loading will produce amplitude and phase shifts with the phase shifts becoming an inseparable part of the signal.

The intermodulation analysis as a means of determining audio system performance as well as suitable equipment for making the tests was presented by J. K. Hilliard. In this test method, two signals of known frequency and controlled amplitudes are fed into an audio system and the output examined for intermodulation factors of these two original frequencies. The fewer and weaker the intermodulation products, the better is the system.

Dielectric preform heater

John Callanan described a continuous dielectric preform heater built for the Firestone Tire Co. to heat 35 lb. tank treads in 1.5 minutes with a 20 kw. 27 mc. oscillator. Synchronized conveyor belts fed 12 preforms into oscillator cage. Automatic coupling control maintained uniform power flow. Equipment is now adapted to preheat washing machine rollers, cutting curing time from 50 minutes to 17 minutes.

Dr. Eugene Mittelman described high frequency heating equipment which he had recently inspected in Europe. He spoke of the more common usage of 100 kw and larger units in England and Switzerland. Units are elaborately engineered and are special jobs rather than designed for production in quantities. Germans appear to have done little work with dielectric and induction heating apparatus was principally rotary generators. One unit of 600 kw was in service in a Berlin factory. Compact, high power induction heating equipment using mercury tubes with external exciter electrodes was mentioned.

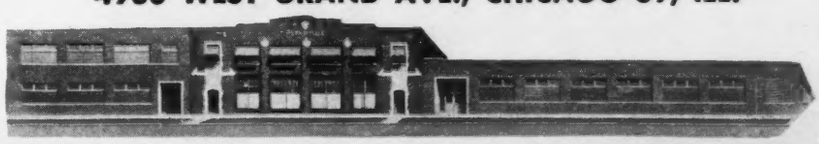
Frank M. Davis

Frank M. Davis, General Manager of the Research and Engineering Division of the Collins Radio Co., Cedar Rapids, Iowa, died of coronary thrombosis February 4, 1946. Associated with the Collins company since 1934, he was widely known for his research and development work in the field of radio communications.

Permoflux Designs Assure Faithful Reproduction!

Because Permoflux Speakers excel in translating the tone capabilities of carefully designed circuits, more and more of the country's outstanding radio manufacturers are specifying them as preferred equipment. Manufactured in a full range of true-dimensioned sizes for every power handling requirement, Permoflux Speakers provide the answer to today's growing demand for better tone quality.

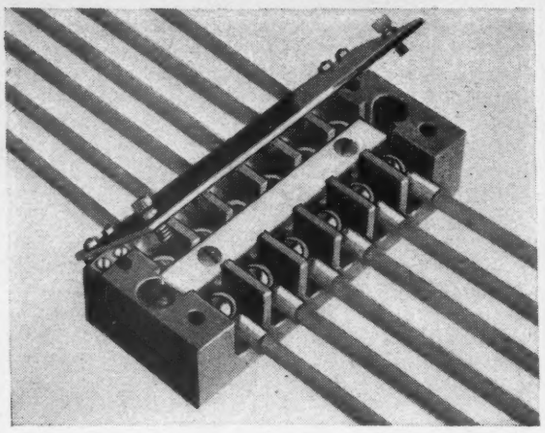
TRADE MARK
PERMOFLUX
PERMOFLUX CORPORATION
4900 WEST GRAND AVE., CHICAGO 39, ILL.

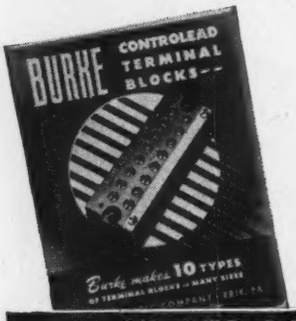


PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

HI-ELECTRICAL RESISTANCE

ALL Burke Blocks except Series 7000 feature 30 Amp capacity. This large block illustrated provides 50 Amp capacity and wide slot opening. It can be furnished with or without covers or with switches. Only available in 6-wire size.





BURKE'S 10 Styles of Terminal Blocks are completely described and priced in a new booklet just completed. Many specials are available to meet unusual conditions. Consult Burke for your Terminal Block requirements.

★ *Write for New Booklet* Address: 1163 W. 12th ST.

AC AND DC MOTORS AND GENERATORS

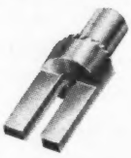
BURKE *Terminal* BLOCKS

BURKE ELECTRIC COMPANY • ERIE, PENNSYLVANIA

When You Want TERMINAL LUGS...

TURRET

SPLIT



DOUBLE END

say **C.T.C.**

These heavily silver plated C.T.C. Terminal Lugs simply swage to the terminal board, provide strong, well-anchored, swift-soldering terminal posts in a jiffy.

C. T. C. Turret Terminal Lugs have two soldering spaces. Lugs heat quickly, make wiring firm and neat. Made to fit 1/32", 1/16", 3/32", 1/8", 3/16" and 1/4" terminal board thicknesses. Also available with single soldering space and in Midget size.

C.T.C. Split Terminal Lugs have a .050" hole through them, permit wiring from top or bottom side of board without drilling. Stocked to fit 3/32" boards. Ideal for transformers and other potted units.

C. T. C. Double End Terminal Lugs provide two terminal posts in one swaging operation. May be wired from top or bottom. Electrical connection perfect. Stocked to fit 3/32" boards. Also available in Midget size.

Write for C.T.C. Catalog 100 today.

CTC

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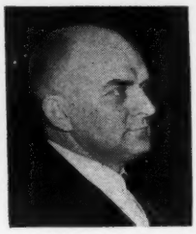
PERSONNEL

A number of changes in the engineering organization of Philips Laboratories, Inc., Irvington, N. Y., recently organized by North American Philips Co., Inc., involve: **Dr. James G. Black** who will be chief of the organization's division of miscellaneous products and its analytical laboratories, moving over from the University of Michigan; **Carol M. Veronda** who comes from the Naval Research Laboratory will be assistant engineer in the microwave section; **Frank Grace,** leaves Sound Laboratories to occupy a similar post in the microwave section; **George A. Espersen** who has been tube division engineer becomes an associate physicist in the microwave section; **Dr. Victor Wouk** joins the laboratory staff at Dobbs Ferry, was formerly with Westinghouse Electric Corp.



Dr. James G. Black

Alexander Norden, pioneer radio manufacturer and founder in 1921 of the Norden Hauck Co. in Philadelphia, has been elected president of the Interstate Mfg. Corp., 125 Sussex Ave., Newark 4, N. J. The company will engage in the production of home and automobile antenna systems among other electrical devices.

Alexander Norden

William E. Bradley

William E. Bradley has been made director of research for the Philco Corp., Philadelphia. He succeeds David B. Smith recently named vice-president in charge of engineering. Bradley, who joined Philco in 1936, becoming a research engineer a year later, is credited with having developed the new Philco advanced FM system and has contributed largely to the development

of a new amplifier theory coming into use in the television industry. He has been assistant director of the Philco research division since early in 1945.

Lt. Daniel S. Karp, son of Milton J. Karp, who is president of the Karp Metal Products Co., Inc., 120 30th St., Brooklyn 32, N. Y., has rejoined the organization as vice-president in charge of engineering and sales. He served 4 years in the U. S. Navy.

Lt. Daniel S. Karp

Fred E. Dole

Fred E. Dole has been appointed research consultant for the J. M. Ney Co., Hartford, Conn. Until recently he was engaged in war research work in the Radiation Laboratory at M.I.T.

Roger T. Furr has been made chief technical service engineer in charge of drafting and physical testing laboratory and the engineering procurement section for Stromberg-Carlson Co., Rochester, N. Y. Other changes in the organization involve **Benjamin Olney** who is to be director of research in the instrument laboratory; **Howard H. Brauer** who moves from the instrument laboratory to the company's engineering staff organization; **Oliver L. Angevine, Jr.,** becomes chief sound equipment engineer.

J. K. Poff has been made service engineer of the jobber sales division of the Astatic Corp., Conneaut, Ohio. During the war he was Chief Naval Inspector of electronic equipment.

A. L. Atherton has been appointed advisory engineer and **Fred C. Heyl,** manager of the quality control department of the Westinghouse Electric Corp., E. Springfield, Mass.

G. Emerson Pray has been placed in charge of management for the Tuck Electronic Corp., with headquarters at 41 Park Row, New York, and 1 Exchange Pl., Jersey City, N. J. The company manufactures testing equipment, radio and television receivers and dielectric heat sealing apparatus.

QUICK DISCONNECT

NEW L-70 SERIES CARTRIDGES

Replaceable needle type.
Streamlined housing.
High output voltage.
Low needle pressure.

Among other improvements in the design of new Astatic Phonograph Pickups is a QUICK-DISCONNECT feature for instant removal or insertion of Crystal Pickup Cartridges. Wire leads on the pickup tone arm are now equipped with special terminal connections which may be slipped on or off the cartridge pins without tools, soldering or unsoldering. Originally, these wire terminals were permanently attached to the cartridge. This new QUICK-DISCONNECT feature, used with both permanent and removable needle type cartridges in newly designed Astatic Pickups, eliminates messy soldering and saves valuable time in service work. Small details, such as this, coupled with the high operating efficiency of Astatic Pickups, contribute to their ever-increasing popularity and usage.

ASTATIC Crystal Devices manufactured under Brush Development Co. patents.

THE Astatic CORPORATION
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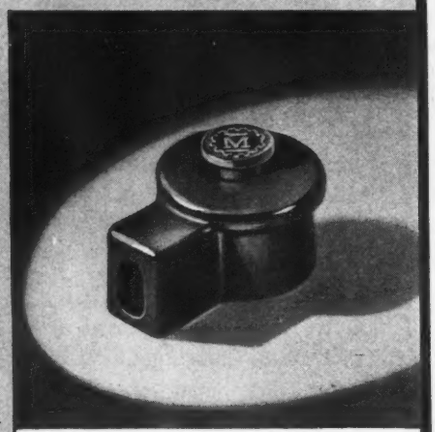
Designed for

Application



THE NO. 36011

Snap-Lock Plate Cap

For Mobile, Industrial and other applications where tighter than normal grip with multiple finger 360° low resistance contact is required, the new No. 36011, "Designed for Application" Plate Cap is now available. Contact self-locking when cap is pressed into position. Insulated snap button at top releases contact grip for easy removal without damage to tube. Molded black bakelite, to fit all tubes with 9/16" diameter contact ferrule.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY

MALDEN

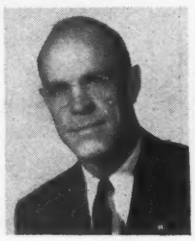
MASSACHUSETTS

Paul H. Reedy has been appointed chief engineer of the engineering research and development department of Columbia Broadcasting System, New York. He joined the department in 1944, will be responsible for the execution of various engineering problems in the laboratories.

Samuel Gubin, formerly with the Radio Corp. of America, Camden, N. J., has joined the staff of Spectrum Engineers, Inc., a newly organized engineering and consulting firm with laboratories located at Preston & Filbert Sts., Phila., Pa.

J. D. Schantz has been promoted to assistant manager of the research department of the Farnsworth Television & Radio Corp., Ft. Wayne, Ind. He came to Farnsworth in 1939 from a predecessor company, Farnsworth Television Inc. of Philadelphia, which he joined in 1936, and where he conducted research on circuits and television terminal equipment.

George D. Clark has been appointed chief engineer of the Russell Electric Co., Chicago. Formerly, he was chief motor engineer for the Packard Electric Division of the General Motors Corp.



George D. Clark

Herbert C. Florance

Herbert C. Florance has been appointed chief engineer of radio station WGHF, New York. He goes to WGHF from the Bureau of Ships, electronic division, before that was connected with NBC and New York's municipal station WMCA.

Frank H. R. Pounsett has been named chief engineer of the Stromberg-Carlson Co., Ltd., Toronto, Ontario. He was formerly chief engineer of the radio division of Research Enterprises Ltd., the crown company which made the radar apparatus in Canada for use by the armed forces. Prior to this connection he was chief engineer of the radio division of the Stewart-Warner-Alemite Corp., Belleville, Ont., and before that was employed by the DeForest Crosley Radio Co.

Widest range of tracer code identification

. . . plus maximum insulation resistance

Spiralon, the newly developed Surco plastic insulated wire, embodies many decided improvements for tracer code identified wire, particularly reduction in weight and space, and smaller sizes of O. D. Spiralon's coding combinations are unlimited with colored spiral stripes, easily and immediately seen. Because the spiraling does not add color pigments to the primary covering, Spiralon retains increased insulating resistance and allowance for greater voltage.

Covered with a nylon jacket, Spiralon also proves highly resistant to fungi and abrasion, eliminates voids, reduces creepage when terminals are being soldered, and injury to insulation when in contact with a hot soldering iron. In fact, all insulating and protective qualities are greatly increased with this thin nylon jacket, which is resistant to high heat and low temperatures, and which raises the rupture point far above that of the average lacquer coating on braid. Send for complete specifications.

- SHIELDED WIRE
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ELECTRICAL INSULATION CO.

84 Purchase St., Boston 10, Mass.

Technology Instrument Co.

Technology Instrument Corp., Waltham, Mass. (1058 Main St.), has been organized for the development and manufacture of electronic and laboratory equipment. The three directors of the firm, H. H. Scott, R. W. Searle and L. E. Packard, represent 46 years of experience in engineering and manufacturing in this field.

H. H. Scott, who will serve as president, will have charge of technical development. A member of the Class of 1930 of the Massachusetts Institute of Technology, he received his S.M. degree the following year and since that time has been associated with General Radio Company as executive engineer. He has worked on the development of sound and vibration - measuring equipment, FM and broadcast station monitoring equipment, and other measuring instruments.

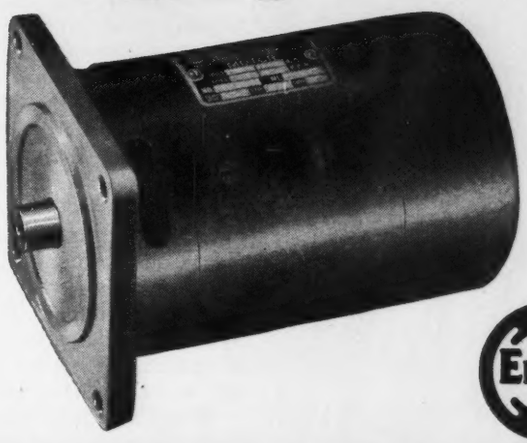
H. H. Scott

L. E. Packard

L. E. Packard is treasurer and in charge of sales engineering activities. After receiving his S.B. degree in electrical engineering in 1935 from the Massachusetts Institute of Technology, he joined the engineering staff of General Radio Co. He spent four years doing development and sales engineering work after which he was successively district manager in GR's New York and Chicago engineering offices. He has specialized in the study of sound and vibration-measuring technics and non-destructive testing of insulation, dielectrics, and bridge methods.

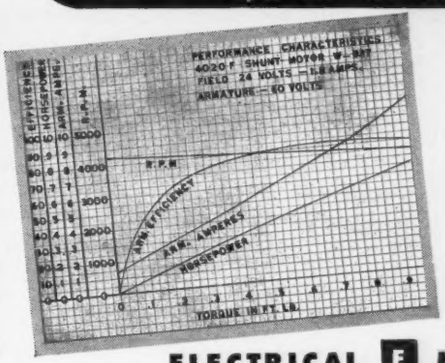
Raymond W. Searle is secretary and production manager of the organization. He has been a member of the production department of General Radio Co. for the past 21 years, the last 15 of which were in a supervisory capacity. He has specialized in the study of labor management and production methods. During the recent war he has been in charge of the Company's branch plant which produced Variacs and precision rheostat potentiometers as well as heading the department in the main plant producing transformers, audio and rf coils, and other parts.

MOTOR DATA
No. 129



EICOR

4000 FRAME MOTOR
1/2 HP at 3900 RPM



The output—the weight—the size—of these 4000 Frame Motors are features well worth remembering. Every adaptation of the standard design is engineered for the precise requirements of an aircraft, portable, or industrial application.

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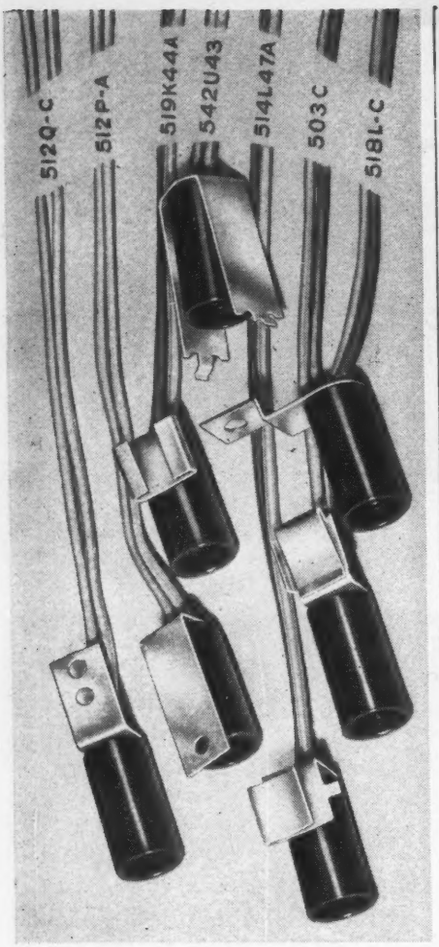
Series, shunt, or compound-wound
Unidirectional or reversible
Optional torque
Optional speed
Optimum efficiency
For control circuits
Electric braking optional

FEATURES

MECHANICAL
Ventilated or enclosed types
Base or flange mounting
Operation in any position
Low space factor
Ball bearing equipped
Optional shaft details
Rugged construction

4000 FRAME MOTORS		4020 Shunt	4020 Series
Watts, Output, Con.	(Max.)	375	746
Torque at 3900 RPM	(ft. lbs.)	.65	1.4
Torque at 6000 RPM	(ft. lbs.)		.88
Speed Regulation		8%	
Lock Torque	(ft. lbs.)	2.5	4
Volts Input	(min.)	12	24
Volts Input	(max.)	110	110
Diameter		4"	4"
Length Less Shaft		7⅛"	7⅛"
Shaft Dia.	(max.)	.625"	.625"
Weight	(lbs.)	9.2	9.2

EICOR INC. 1501 W. Congress St., Chicago, U.S.A.
DYNAMOTORS · D. C. MOTORS · POWER PLANTS · CONVERTERS
Export Ad Auriema, 89 Broad St., New York, U.S.A. Cable Auriema, New York



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DRAKE patents plus modern high speed methods and machinery go a long way toward achieving the traditional excellence and economy of our products. It should pay you in better performance and *lower costs* to specify DRAKE for all of the Socket and Jewel Light Assemblies you need. Ask for prices and the newest Drake Catalog.

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Radio Circuits Printed on Ceramic

Born of development work on the Navy's proximity fuse, and now revealed for the first time, radio circuits can be "printed" on ceramic plates to take the place of the usual wiring. Dr. Cledo Brunetti of the National Bureau of Standards told a meeting of IRE at the Marquette University this about the process:

"On a ceramic plate," he said, "is laid a silk mask with a pattern cut in it. Over this mask is drawn a plastic bar, like the rollers of a printing press, with a thick paste of dissolved silver. The impression left on the plate is like the wiring of the circuit, only instead of copper wires we have silver lines.

"Next another mask is placed over the plate and sprayed with a carbon solution. When the mask is removed there are all of the resistors assembled in a circuit. Thin condensers are attached to the circuit and the wiring is completed."

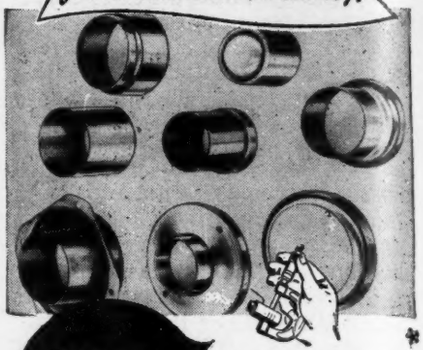
New Radio Design Eliminates Wiring

The Promenette Radio & Television Corp., Buffalo, N. Y., will manufacture home radio receivers which, the firm claims, are revolutionary in design. All connecting wires are eliminated by means of bare metal sprayed into channels of a plastic chassis. According to Bede B. Berger, president, this method will speed production tenfold, reduce operating costs, permit considerably lower prices, improve set performance.

New Clarostat Officers

New officers and directors have been elected to direct the Clarostat Mfg. Co., Inc., Brooklyn, N. Y., following the retirement of the three Mucher brothers who founded the company a quarter-century ago. Former general manager Victor Mucher is now president; George Mucher, in addition to holding the post of chief engineer which he has held for many years past, is vice-president; William Mucher is the treasurer; and Charles Burnell, who has long handled the legal, patent and labor-relations activities of the company, is secretary. These Muchers are the younger generation of the family of the founders and have grown up in the business. The new directors are the officers, together with B. G. Cantor, a New York financier.

for dimensional accuracy!



METAL STAMPINGS

DKE

Specialized DKE experience — over 20 years in the field—is now available for the production of stamped metal parts. All types of cups, sleeves, flanged shapes, intricate single pieces or fabricated components are included. High quality workmanship to exacting specifications—with any desired finish — is embodied in every job.

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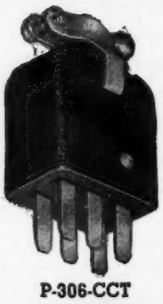

P-306-CCT

S-306-AB

A high quality line of small Plugs and Sockets adaptable to a thousand uses. All Plugs and Sockets are Polarized. "Knife-switch" Socket contacts are of phosphor bronze, cadmium plated. Bar type Plug contacts are of brass, silver plated.

Insulation is of BM 120 molded Bakelite. Caps are of metal with formed fibre linings. Made in 2 to 33 contacts. Although designed for 45 volts at 5 amperes, these Plugs and Sockets can be used at higher ratings where circuit characteristics permit. 2 contact round, others rectangular. For additional information write today for catalog No. 14 showing complete line of Electrical Connecting Devices.

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NEW BOOKS

Major Instruments of Science and Their Applications to Chemistry

Edited by R. E. Burk and O. Grummitt. Vol. IV in series, Frontiers in Chemistry. Published by Interscience Publishers, Inc., 215 Fourth Avenue, New York 3. 1945. 151 pages, price $3.50

This book is the fourth of a series by these editors on "Frontiers of Chemistry," all of which have been prepared under the auspices of Western Reserve University by distinguished scientists in particular fields of research and industrial chemistry to prepare technical reviews on some subjects in their field of activity.

The subjects covered in this volume are:

(1) "Electron Diffraction," by L. H. Germer of the Bell Telephone Labs., who reviews the development of this technic, describes the process and explains its utility in crystallography.

(2) "The Electron Microscope," by L. Marton of Leland Stanford University, taking up the theory, construction and applications of these instruments.

(3) "X-ray Diffraction," by M. L. Huggins, Eastman Kodak Co., Rochester, N. Y. In addition to a discussion of the principles involved and instruments used, a review of methods of molecular structure analysis both inorganic and organic, is included.

(4) "Chemical Spectroscopy," by W. R. Brode, Ohio State University, describing chemical analysis by emission spectra.

(5) "Application of Absorption Spectra to Chemical Problems," also by Dr. Brode, which adds details of absorption and resonance forms of spectrographic analysis.

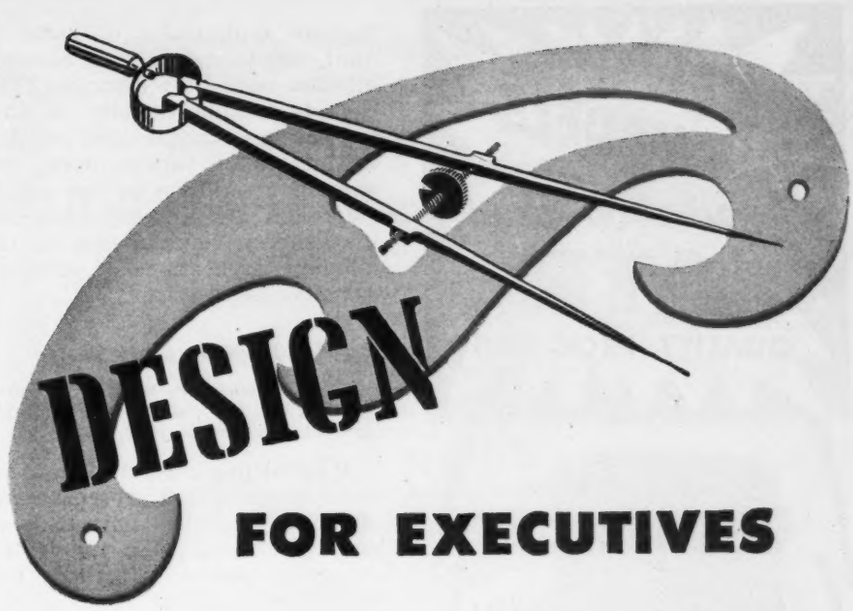
(6) "The Infrared Spectrometer" section by R. B. Barnes of the American Cyanamid Company of Stamford, Conn., describes the history, development, apparatus details and its operation of this form of spectrography.

In each section a selected bibliography is included, and a general reference index covering all sections.

Two-Way Radio

By Samuel Freedman, Commander U.S.N.R. Published by Ziff-Davis Publishing Co., Chicago, 1946, 506 pages, illustrated. Price $5.00.

This book deals with the systems utilized in two-way or point-to-point radio communications and the equipment used in the process.



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Through its Modern Business Course and Service, the Alexander Hamilton Institute prepares men for executive positions quickly and scientifically. Institute training is basic and broad. It provides the knowledge that enables men to direct the activities of others—not in one department or one kind of business—but in *all* departments of *any* business. It covers Accounting, Marketing, Finance and Production.

Training of this kind is particularly valuable to technical men who are often denied responsible, high salaried positions because of their lack of business knowledge. The Modern Business Course and Service supplements their technical education, and qualifies them for rapid advancement.

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Among the contributors to the Institute's training program are such business and industrial executives as HermanSteinkraus, President, Bridgeport Brass Company; Thomas J. Watson, President, International Business Machines Corp. and Clifton Slusser, Vice President, Goodyear Tire & Rubber Company.

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The manner in which the Institute's Modern Business Course and Service is brought to subscribers is interestingly told in the fast-reading pages of "Forging Ahead in Business." The booklet also contains a great deal of information about the problems facing ambitious men who are looking ahead—and who want to move ahead.

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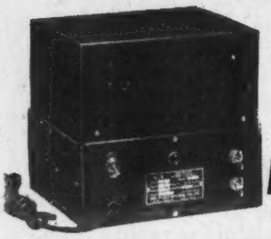


ATR "A"
BATTERY ELIMINATORS
FOR CONVERTING A.C. TO D.C.
New Models . . . designed for testing D.C. electrical apparatus on regular A.C. lines. Equipped with full-wave dry disc type rectifier, assuring noiseless, interference-free operation and extreme long life and reliability.
- Eliminates Storage Batteries and Battery Chargers.
- Operates the Equipment at Maximum Efficiency at All Times.
- Fully Automatic and Fool-Proof.

ATR
LOW POWER INVERTERS
FOR INVERTING D.C. TO A.C.
Another New ATR Model . . . designed for operating small A.C. motors, electric razors, and a host of other small A.C. devices from D.C. voltages sources.

ATR

STANDARD AND HEAVY DUTY INVERTERS
FOR INVERTING D.C. TO A.C.
Specialy designed for operating A.C. radios, television sets, amplifiers, address systems, and radio test equipment from D.C. voltages in vehicles, ships, trains, planes, and in D.C. districts.
WRITE FOR NEW CATALOG — JUST OFF THE PRESS!

AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
ST. PAUL 1, MINN. U. S. A.

Various applications of radio to fixed, mobile and portable communication system are described. The book is "enthusiastically" written and covers the advantages and disadvantages of various basic systems, a description of the equipment and accessories needed and the problems encountered in the different applications of point-to-point communications.

Radio Test Instruments

By Rufus B. Turner. Published by Ziff-Davis Publishing Co., New York-Chicago, 1945. 228 pages, 216 illustrations, $4.50.

Of particular interest to amateur radio operators and experimenters, this book describes how to construct the great majority of instruments commonly used in the design and testing of electronic equipment. Since the text is mainly concerned with the construction and basic operation of the various instruments, no generalized theory is provided and there is no attempt to discuss applications and operating technics in detail. Nevertheless, this small volume forms a very complete and concentrated source of information on a neglected subject. The illustrations consist of wiring diagrams and photographs of the completed instruments.

A.S.T.M. Standards on Electrical Insulating Materials

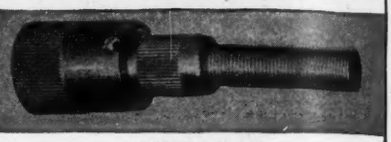
Prepared by A.S.T.M. Committee D-9 on Electrical Insulating Materials, published by American Society for Testing Materials, 260 So. Broad St., Philadelphia 2, Pa. 545 pages, $3.25.

This compilation gives more than 75 specifications and test methods on insulating materials and numerous others on related products.

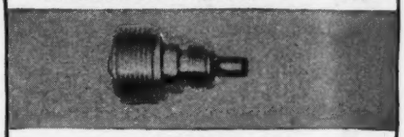
Fastener Installation

A booklet describing a new installation procedure which reduces by fifty per cent the time required to install Dzus fastener studs has just been issued by the Dzus Fastener Co., Inc., Babylon, N. Y. Use of a newly developed grommet eliminates separate operations for inserting, setting and clinching the grommet formerly required. The new time-saving procedure may be used with practically all types and sizes of Dzus fasteners. In addition to achieving marked savings in time costs, the quicker, simpler installation procedure greatly facilitates use of Dzus fasteners in mass production operations. It also simplifies the replacement of fastener studs in the field.

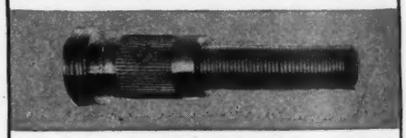
KINGS Electronics
NEW IMPROVED AND STANDARD MICROPHONE JACKS AND PLUGS



MODEL M-151
Improved and Standard Type Microphone Jacks and Plugs
Solid, silver plated contact coupling can be unscrewed completely for soldering.

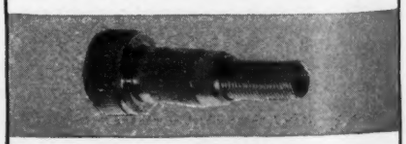


MODEL M-161
Chassis mounting, solid silver plated contact. Milled flat prevents turning.



MODEL M-170
Mates with Model M-151 and M-150 standard solder contact.

MODEL M-160
Chassis mounting standard. Solder contact.



MODEL M-150
Standard solder contact. Mates with Models M-170, M-161, and M-160.
PRICE AND DELIVERY UPON REQUEST
SEND FOR OUR LATEST BROCHURE

KINGS ELECTRONICS CO.
372 CLASSON AVE., BROOKLYN 5, NEW YORK

Washington-N. Y. Telecast

The Lincoln Memorial ceremonies in the nation's capital were the occasion for the first regularly-scheduled inter-city television broadcast from Washington to New York on Tuesday, Feb. 12. Using the Bell System's coaxial cable, the television systems of the National Broadcasting Co., the Columbia Broadcasting System and the Allen B. DuMont Laboratories joined in bringing this special program to viewers in New York and Washington.

Television cameras operated by crews of all three broadcasters were located in front of the Capitol, in the studios and at the Lincoln Memorial. The television images traveled from the cameras over specially equipped telephone wires to the Washington terminal of the coaxial cable, and thence over the cable 225 miles to New York. From the terminal in the Long Lines building in New York the images traveled again over specially equipped wires to the television transmitters of station WNBT (NBC) and WCBW (CBS). The images were fed direct to station W3XWT from the Washington terminal. Each of the three broadcasters will have use of the cable two nights a week for experimental use of the intercity television facilities. For the present, direction of transmission will be from Washington to New York.

N. Y. Public Library to Feature Tele

Six television receiving sets are being installed in branch libraries of the New York Public Library. These have been provided by the Dumont Laboratories, Inc., and the Farnsworth Television and Radio Corp., and will represent an experiment with a new technique in adult education.

In addition, Farnsworth is installing a complete telecast studio in one branch library—$200,000 worth of equipment including an electronic television camera, control equipment, receiver, lighting, scenery and properties. The College of the City of New York is providing courses in television to be given in this laboratory which will also serve as a demonstration open to the public.

"The Library, for its part, is attempting to build up its book collection in this field of greatly increasing interest," explains F. R. St. John, chief of the Circulation Dept., who requests donations of

Drillet Box Jig Saves Up to 75% of Jig Body Expense and Labor!

The six-sided Drillet Box Jig above and at right has a range of 125 different sizes, making it possible to accommodate all sizes up to 6" capacity—for drilling, reaming, counter boring, counter sinking, spot facing, tapping, etc.

The Drillet Box Jig makes special tool design for drill jig unnecessary. Saves up to 75%-of the time and cost of building a jig body. By merely turning thumbscrews and raising leaf, parts may be quickly loaded or unloaded. The jig may be used on all six sides, taking advantage of its full capacity.

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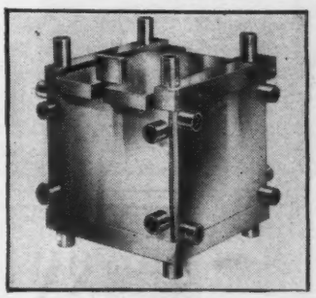
Besides the satisfaction chewing gives you, it helps keep your mouth moist and fresh so you naturally feel better—and feeling better you work better.

Scores of industrial plants report that they have stepped up their workers' morale and efficiency by making chewing gum available to them.

You can get complete information from The Chicago Drillet Corporation, 920 S. Michigan Ave., Chicago 5, Ill.



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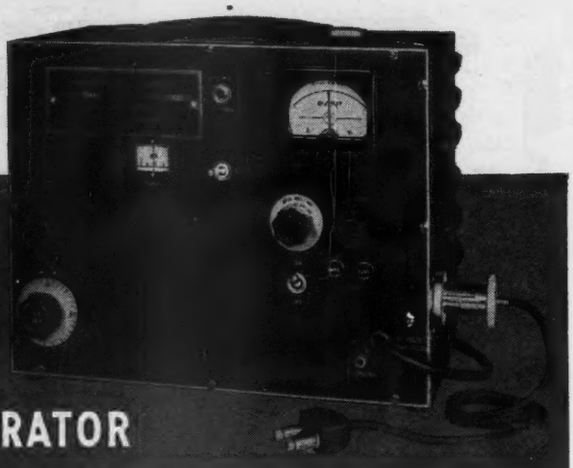

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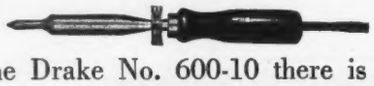

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standard television volumes for the branch libraries which will have television sets. Each branch collection will serve as a model library for students and others who are developing television libraries of their own. In addition a reading list, including gifts, will be printed for distribution.

Intra-Store Television

Intra-store television experiments carried on by the Gertz department store, Jamaica, Long Island, were demonstrated recently. Simplified equipment, especially designed for the purpose by William B. Still, head of Jamaica Radio & Television Co. and operator of station W2XJT, was used to present merchandising and entertainment features to the store's customers. The programs were shown via six coaxially connected receivers strategically located about the store to catch shoppers' interest. The installation is proving valuable as a demonstration of what can be done to make small scale, limited budget television practical for stores, schools, etc.

Television Applications Filed For 187 Stations

As of the first of the year there were 19 licensed television stations in the United States, six of them commercial stations and 13 operating under experimental licenses. At the same time, reveals Federal Communications Commission, construction permits have been issued for three more commercial and 13 experimental stations. Complete data on the television situation follows:

Lic. Comm. Stations	6
Lic. Exp. Stations	13
Lic. Exp. Relay Stations	29
Const. Permits for Comm. Stations	3
Const. Permits for Exp. Stations	13
Comm. Const. Permit Applications	142
Exp. Const. Permit Applications	9
Exp. Relay Const. Permit Applications	20

NARBA Conference Opens

FCC Commissioner E. K. Jett, who was elected permanent Chairman of the Conference, and Francis C. DeWolf, Chief, Telecommunications Division, Department of State, were the key figures in the opening of the North American Regional Broadcasting Engineering Conference which began in Washington Feb. 4 and was expected to end Feb. 15. The conference was held to determine extent of the NARBA agreement signed by six countries in 1937 and which expires March 29, 1946.

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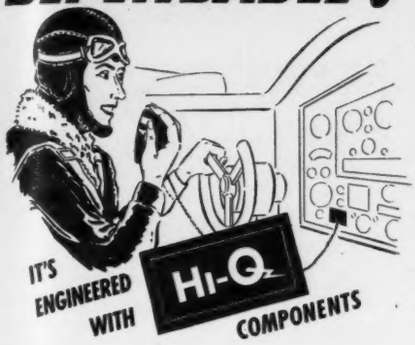

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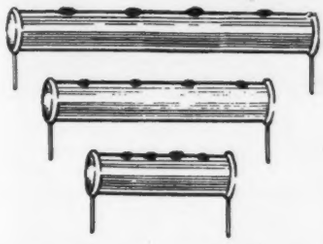
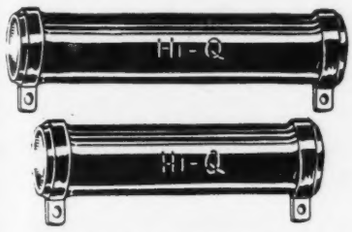
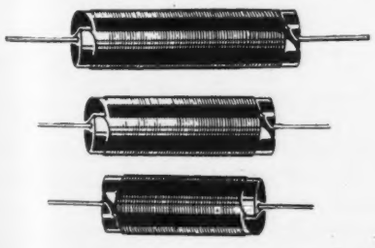


Hi-Q Ceramic Capacitors are of titanium dioxide (for temperature compensating types) and are tested for physical dimensions, temperature co-efficient, power factor and dielectric strength. CI type with axial leads; CN type with parallel leads.



Hi-Q Wire Wound Resistors can be produced promptly and in quantity — with quality physical specifications and high performance electric specifications.



Hi-Q Choke Coils are uniform in their high quality performance. Ruggedly constructed for long service.

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UHF Wattmeter

Designed to measure the uhf power output of inductivity coupled transmitters, a new type of wattmeter has been developed by the Bird Electronic Corp., Cleveland, Ohio, for use from 20-750 mc, and from 5-100 w. Its essential features are a series-type thermocouple, a 50-ohm high loss line, and an 0-1 ma dc meter to read the drop across the terminating resistor. Calibration charts are provided to relate transmitter frequency and effective power output. Calibration is obtained by comparison methods. A schematic diagram of the equipment reveals that current heats the thermocouple junction, resulting in direct current through the line proportional to the square of the rf current. Deflection of the dc meter is proportional to thermocouple dc, indicating the amount of uhf transmitter power. Skin effect and other conditions cause the resistance of the thermocouple wires to increase with frequency. The transmitter frequency may be determined within 2%, from the calibration curves. Power is dissipated partly in the high loss line and partly in the terminating resistor. A blower serves to dissipate this heat. At 160 mc about 90% of the power is dissipated in the line and 10% in the resistor. At higher frequencies more power is dissipated in the line and less in the resistor. The line attenuation of 9-1/2 db at 160 mc serves to reduce the magnitude of error resulting from possible standing waves.

Inspection Booths

Improved types of inspection booths have been developed and are in use at the Aireon Mfg. Corp., Kansas City, Kans. These booths were designed for quality testing of purchased products. It has been found that four different types of

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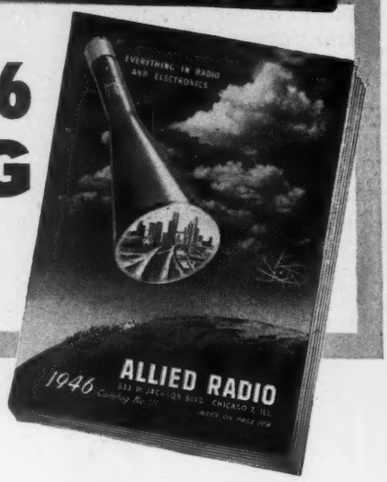

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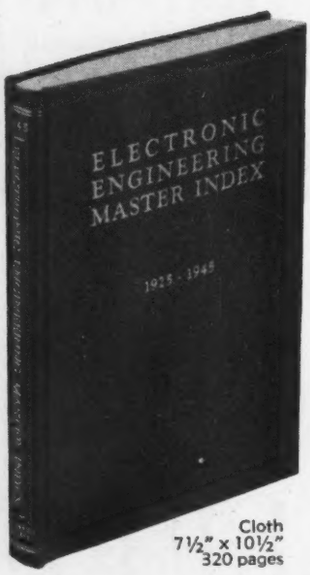

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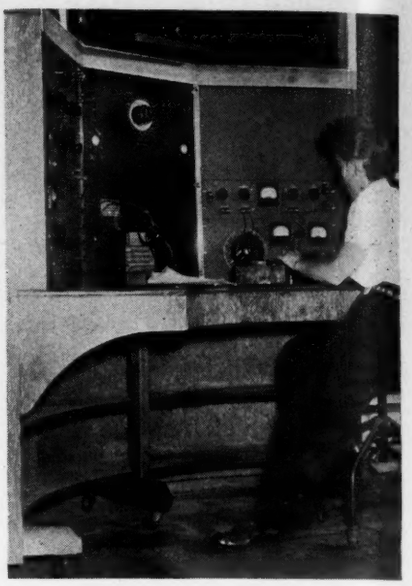
booths were sufficient to provide the voltages and meters needed to test the whole line of products used by the company. Only spot-checks



View of inspection booth used for testing of products received by the manufacturer. Operator is shown testing the performance of a transformer with the provided meters.

are made, since the standards of manufacturers of component parts have been set at a high level in the last few years. A high chair insulated from the floor by rubber wheels has been provided. The individualization of inspection permitted by the compartments results in a considerable saving of time in the testing of a large number of component parts.

Organization to Administer Patent Rights?

A joint Army-Navy Committee has filed recommendations that a cooperative non-profit organization be established to administer electronic patents resulting from the radar program and to license manufacturers to take advantage of these developments.

A committee report explained that: "The secretaries of both departments have recognized that uncertainty as to ownership and scope of patent rights, and particularly as to the methods under which the government-owned patents were to be administered, might seriously delay further development in electronics, and prevent the application of new techniques to production for both military and civilian use. . . .

"There have been and are now before Congress various pending bills prescribing the methods of ad-

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ministration and disposition of government-owned patents and inventions. Some of the pending legislation calls for granting licenses under such patents, while other bills would dedicate them to the public. Until Congress settles which of these conflicting principles is to prevail, no official detailed Army-Navy proposals can be promulgated without danger of their being made inconsistent with governmental policy by the passage of general legislation."

The committee found that "privately held electronic patent rights are so widely dispersed in ownership, so interrelated in subject matter, and so numerous that obtaining licenses on an individual basis is practically impossible, either to industry or to the government.

"Patents in the electronic field can therefore best be handled by a cooperative non-profit organization which would administer substantially all patents in the field for the benefit of their owners, the industry at large, and the public. Anyone could then obtain all rights necessary for manufacture by taking a single license from such an organization."

Production Tools

A new loose-leaf reference book shows the various types of dummy tubes, pin straighteners, masking plugs, testing fixtures and gages and special production tools made by Robert L. Stedman Machine Works, Oyster Bay, Long Island, N. Y. A section of graphical symbols for telephone, telegraph, radio and electronic use also is included, making this book a valuable help for production planning and methods work.

Photoelectric Control

A new folder showing some of the uses of Photo-troller automatic control equipment is available from the Westinghouse Electric Co., Pittsburgh, Pa. Charts are included giving maximum distances and minimum light intensities necessary for the proper operation of the various models. An infrared filter to make the light beam invisible, a solenoid valve for controlling drinking fountains and a magnetic counter for counting operations also are covered.

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Broadcast Engineering Conference, March 18-23

Plans have been completed for a resumption of the Broadcast Engineering Conference, suspended during the three war years. The sixth annual gathering will be held in Campbell Hall on the Ohio University Campus at Columbus during the week of March 18-23. In addition to a long program of technical reports there is to be an exhibition of new broadcast equipment. Following is the program:

Monday, March 18

9:00 am to 11:00 am—Contributions of War Developments to Broacasting—A. B. Chamberlain, Chief Engineer, Columbia Broadcasting System.
11:00 am to 1:00 pm—Symposium on Broadcast Maintenance Problems—A. J. Ebel, Chief Engineer, University of Illinois Radio Service, Chairman.
2:30 pm to 4:30 pm—Design of Broadcast Studios with Irregular Boundary Surfaces.

Tuesday, March 19

9:00 am to 11:00 am—Antenna Patterns and the Antennalyzer—George H. Brown, Research Engineer, Radio Corporation of America.
11:00 am to 1:00 pm—Symposium on Recording Technics—Lynne Smeby, Associate Director, Operational Research Staff, Office of the Chief Signal Officer, U. S. War Department.
2:30 pm to 4:30 pm—General Acoustical Problems in Broadcasting—E. J. Content, Station WOR.
8 pm—Popular Scientific Lecture.

Wednesday, March 20

9:00 am to 11:00 am—Symposium on VHF Antenna and Coupling Circuits—E. C. Jordan, Department of Electrical Engineering, University of Illinois, Chairman.
11:00 am to 1:00 pm—Symposium on Tele-

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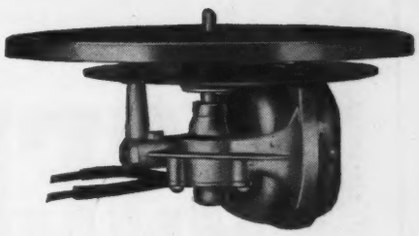

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vision Station Operation—Robert E. Shelby, National Broadcasting Company, Chairman.
2:30 pm to 4:30 pm—Radio Relays, for FM and Television.

Thursday, March 21

9:00 am to 11:00 am—Stratovision—Ralph Harmon, Westinghouse Electric Corp. and representatives from Glenn L. Martin Aircraft Co.
11:00 am to 1:00 pm—Symposium on Field Question Box—A. D. Ring, Consulting Engineer, Chairman; John Willoughby, Assistant Chief Engineer, Federal Communications Commission, in charge of Broadcasting; also representative chief engineers from broadcasting stations.
2:30 pm to 4:30 pm—Interconnecting Facilities for FM and Television Broadcasting—H. I. Romnes and W. E. Bloecker, American Telephone and Telegraph Co.
6:30 pm—Banquet, F. N. Hayes Hotel.

Friday, March 22

9:00 am to 11:00 am—High Powered Tubes for VHF Operation—W. W. Salisbury, Collins Radio Co.
11:00 am to 1:00 pm—Symposium on FM Operating Problems—Phillip B. Laeser, Milwaukee Journal Co., Chairman.
2:30 pm to 4:30 pm—Symposium on FM Monitors—R. C. Higgy, Director WOSU, Ohio State University, Chairman; D. B. Sinclair, General Radio Co.; Frank Gunther, Radio Engineering Laboratories; H. R. Summerhayes, Jr., General Electric Co.

Saturday, March 23

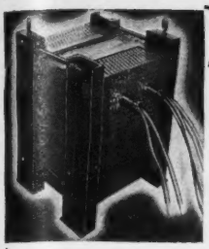
9:00 am to 11:00 am—Symposium on PM Modulation Methods—W. L. Everitt, Head, Department of Electrical Engineering, University of Illinois, Chairman.
11:00 am to 1:00 pm—Round Table and Experiences in VHF Propagation—Raymond M. Wilmotte, Consulting Engineer, Chairman.

Germany's UHF Tubes

Some information on German equipment has been released by the U. S. Department of Commerce (Publication Board) based on personal reports by the members of the Combined Intelligence Objectives Sub-Committee, who are making studies of German industrial and military equipment and the status of research. During the next few months, digests of reports on the most interesting items relating to electronic matters will be published here. The complete reports are available from the U. S. Department of Commerce, Washington, D. C. —Editors.

• Much curiosity has been exhibited about radar technics in Germany. Some of the reports were concerned with attempts at counter measures.[5] In one laboratory, research was conducted on methods and materials capable of absorbing electromagnetic radiation. One of

[5]Report Index Number, 69.



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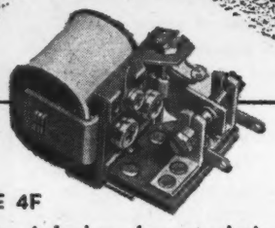

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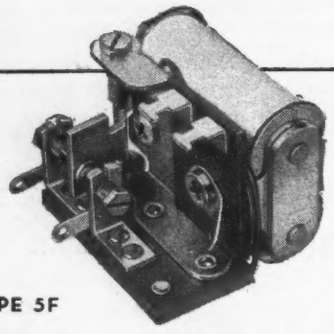

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these materials consisted of spiral steel shavings imbedded in paraffin, which was named Eisenspaene. Another material tested was called Moltspren, both developed for the concealment of submarines.

In 1943, measurements of reflection coefficients of submarines and aircraft were made at a wavelength of 6.8 cm. Measurements were made to determine the effect of varying the width of strips of "window", a name given the metal strips dropped by Allied aircraft to confuse German radar indications.

Split beam antenna

Other work concerned an antenna system to give a narrow beam in the vertical plane and broad in the horiontal plane, and to scan in elevation, for use with a PPI indication. In order to obtain DF in azimuth, a split beam system was used in conjunction with a rotating color filter in front of the CRT. Signals from the two beams are given different colors—red to port, and green to starboard. If a target is ahead (in both beams) the signal appears to be a combination of red and green.

The DF system, known as "Susel", was an attempt to produce a high frequency version of the well-known low frequency "sum and difference" principle of measuring the rf phase difference between received voltages from two similar antennas. The indicator system is a CRT, and a straight line (collapsed Lissajous figure) is produced at an angle θ to the time base, where $\theta = na$, a being azimuth angle for target station and n depending on antenna characteristics.

Anti-window receiver

Systems were developed using range time base for anti-window work, and also a search receiver version with swept frequency of the receiver locked to the time base. It should be noted that the receiver is rf throughout. A centimeter version of the equipment was demonstrated; this used two polyrod antennas for 10 cm, and a double if of 30 and 7 mc. Much difficulty was experienced in obtaining accurate balance of the two mixers (the local oscillator is, of course, common). The system provides for fast DF and has anti-window possibilities.

A warning receiver "Hela" covered the range 10 cm to 2 meters.[6]

[6]Report Index Number, 78.

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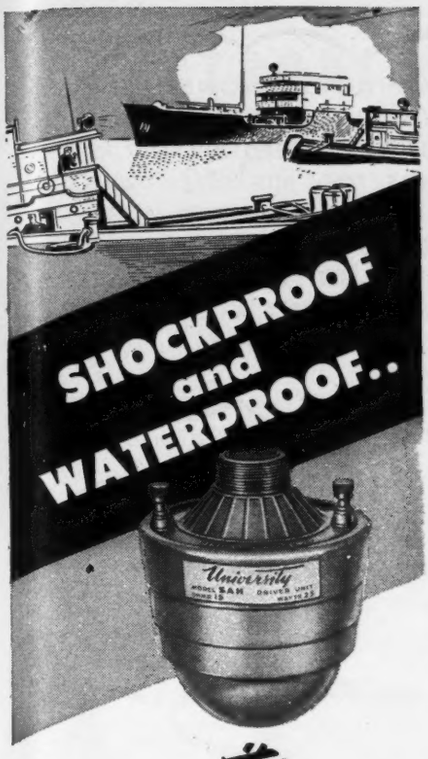

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Three dipole systems were used, each covering a 3:1 frequency range. The German Navy apparently produced an additional antenna system which had directional properties.

The receiver has a crystal detector and an amplifier which covers the band from 30 to 300 kc. CRT indication used with this receiver involved a triggered time base with five sweep speeds made available and suitable for pulse recurrence frequencies from 15 per second to 2 or 3 kc. The gain of the amplifier was such that noise could be observed, but the overall sensitivity was very low.

Some directional finding work was done for the German Navy using special 4- and 8-segment electrometers of very high sensitivity.[7] A major problem, drift of the DF minimum, was thought to be due to antenna interaction, but it was impossible to establish this experimentally. Several methods of introducing sense into the system were tried, both with artificial targets and by producing asymmetry artificially by loading one of the segments with a capacity to earth.

Radar receiver

A 1.5 meter radar receiver and indicator described had one rf stage, a tuned circular Lecher wire oscillator and 3 intermediate frequency stages on 23 mc. The indicator consisted of an oscilloscope with a 150 km time base on which were added large calibration pips every 50 km and small pips every 10 km. The first 50 km portion of the time base could be expanded and an accuracy of plus or minus 30 meters obtained. This accuracy was realized by triggering a multivibrator through a delay line portions of which were tapped off by a double contractor arrangement in 30 meter steps.

Another receiver indicator setup included expansion of any one of the three 50 km sections of the time base. A 75 cm Lecher-tuned receiver used acorn tubes similar to 954 and 955 types are tuned oscillator and mixer respectively, followed by three intermediate frequency stages at 23 mc. The indicator used could also expand any of the three 50 km sections of the time base.

A PPI tube using rotating magnetic deflection, a long persistence screen, intensity modulation, black-

[7]Report Index Number, 93.

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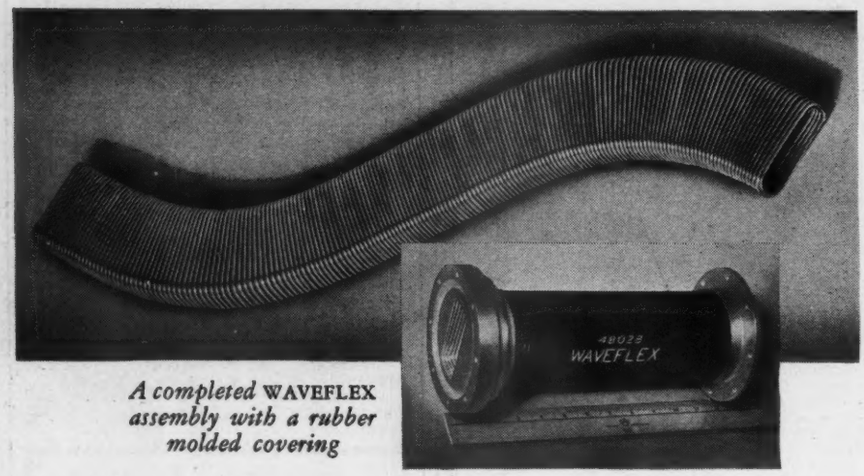

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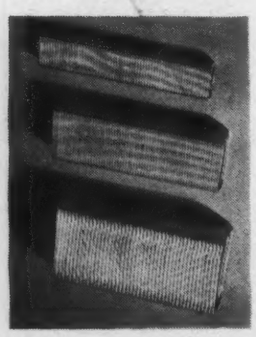

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ing out of the main pulse at the center of the tube was found. Experiments were conducted on automatic sector scan using electrostatic deflection. It happened that these developments in a French laboratory (LMT) were unknown to the Germans.

A pulse altimeter also was developed and found satisfactory consisting of an acorn tube transmitter with a 0.3-microsecond pulse at 3,000 volts on the plate of the tube, transmitting on 2 meters at a pulse recurrence frequency of 1800 pulses per second. The receiver used the same type of construction as the 75 cm receiver.

A radio frequency bridge was developed to work at frequencies between 2 and 4 meters, the need for which arose because Allied use of window had effectively jammed the German 50-60 cm radio chain but had little effect on radar operation in the 2-4 meter band. Consequently the Germans decided to expand the 2-4 meter coverage to put into service new stations with six push-button frequencies between 2 and 4 meters. The stations were equipped with broad-band antenna systems and the bridge was necessary to facilitate a rapid matching of the complicated Wasserman antenna. The original model of the bridge used a crystal detector, but this had to be changed to a diode because the sole German crystal manufacturer, a small specialist in Berlin, had his plant destroyed by British bombing.

There were three types of Wasserman stations, each identical except for the towers. Heights information was obtained by a shifting of the vertical polar diagram with hand control, by varying the relative feed lengths to the upper and lowed bays of dipoles in the Wasserman antenna. Reflector switching at 50 cycles per second was used to secure a form of split on the horiontal beam to assist in more accurate DF.

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